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THE ANNALS

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ANNALS
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No. 1

I

ANTIBIOTICS IN THE TREATMENT OF DISEASES
OF THE EAR, NOSE AND THROAT

A. C. FURSTENBERG, M.D.

ANN ARBOR, MICH.

In this era of pervasive and uncontrolled utilization of the antibiotics, there is justification, perhaps, for another review of therapeutic principles and a plea for their more thoughtful and sounder application. With the discovery of penicillin, its allied agents, and their mass production, clinicians have employed them in different forms and by various methods for almost every illness in the category of medicine. The urge to administer appears to transcend therapeutic rationale and provokes the use of the antibiotics for purposes often obscure and irrelevant.

It is only natural that great inventions and discoveries should gain wide acclaim and enthusiastic endorsement and enjoy universal acceptance far in excess of that which they merit. The antibiotics are typical examples. Their usage knows no limitations in the practice of otolaryngology and methods for their administration, I'll venture to say, will be restrained only when man's ingenuity fails him in finding some new way of blowing or squirting the agent into the human organism.

Read before the Chicago Medical Society.

Fortunately, in medicine we can look forward hopefully to a reactionary wave which ultimately reduces a new discovery to its true value. Medical investigators are rapidly placing the antibiotics on the block of analysis, exploring their merits and classifying them in accordance with intelligent and practicable principles of utilization.

In the case of penicillin these principles are clear cut and well defined. They should be kept constantly in mind and sedulously employed if one wishes to administer penicillin in a rational and scientific manner.

The first principle, well known to the profession, is an obvious one, namely, that penicillin is a powerful antibacterial agent for organisms for which it is specific. The vast majority of patients with acute suppurative otitis media, furunculosis of the external auditory canal, or acute nasal accessory sinus disease will respond promptly and effectively to the parenteral use of penicillin. The response, however, should not be delayed beyond a period of 72 hours. If resolution of the inflammatory process does not occur within this time, to the extent that the patient is free from pain, recovering from general reactive symptoms and exhibiting a decrease in the quantity of purulent discharge from the ear or nose, it is likely that one is dealing with an organism resistant to penicillin and not amenable to this form of therapy. Unabated signs and symptoms of the acute infection call for bacteriological examinations in an effort to identify the responsible organism and to determine its sensitivity to the available antibiotics.

It would, of course, be an ideal in medicine if one might employ bacteriological studies in every case of infection. Is the organism sensitive to penicillin is a question we should like to have answered in every instance of acute inflammatory disease. But it is doubtful that a standard of such perfection is obtainable in the practice of medicine today. It would be time-consuming and costly, and delay in instituting specific therapeutic measures might prolong suffering and cost lives.

There can be no criticism of the present day practice of the immediate administration of penicillin when the diagnosis of acute infection is made, yet derision is justifiable when the antibiotic is used indefinitely in the face of an unsatisfactory response. If an acute infection in the middle ear, external auditory canal or nasal accessory sinus is resolutely rebellious to penicillin therapy, it is exceedingly important to identify the organism, determine its

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sensitivity or resistance and shift to another antibiotic if the exigencies demand.

In the practice of otolaryngology one occasionally observes a meningitis of otitic or sinus origin which fails to reveal the causative organism in the spinal fluid. Unmistakable signs and symptoms of the disease are present. The spinal fluid is under pressure and cloudy. It shows a high cell count and other unquestionable laboratory evidences of a diffuse meningitis are observed.

Here, one is dealing with a killing disease. In spite of all available therapeutic measures today, the mortality of pneumococcic meningitis remains approximately 60%. The situation is too critical to permit temporizing procedures until cultural studies demonstrate the true identity of the infection. Delay is unwarranted and prompt administration of both penicillin and streptomycin intramuscularly and intrathecally is commendable therapeutics.

The matter of whether penicillin or streptomycin needs to be employed intrathecally in meningitis is at present a controversial issue. Our clinical observations give rise to the belief that this form of therapy has some advantage over that in which the intramuscular injections alone are employed. The trend of recommendation today is, I believe, to use these antibiotics both systemically and intrathecally when one is dealing with this dreaded disease. Moreover, one might also advantageously employ the newest antibiotics, aureomycin or chloromycetin, when so critical a condition as meningitis is at hand. In short, everything that is available should be employed when we are unable to reduce this serious problem to one for which a specific antibiotic will furnish the solution.

Aureomycin and chloromycetin, the most recent therapeutic discoveries, are exceedingly promising antibiotics. Their action is interesting to a phenomenal degree. Current investigations have indicated that they are effective when given by mouth; they permeate cell membranes and are therefore particularly useful in the treatment of the intracellular infections (rickettsial diseases). In our limited experience they have not given rise to any of the toxic symptoms which have occasionally restricted the use of the other antibiotics. Among their many promising features, they seem to overcome the cellular barrier to the spinal fluid; when given by mouth they yield a concentration in the spinal fluid equal to 50% of that observed in the blood serum. Their ability to permeate cell membranes, their consequent intracellular action and their rapid

dissemination to the spinal fluid, make them agents of great promise in the field of the antibiotics.

The second important principle governing the effectiveness of penicillin is that the antibiotic must come in actual contact with the organism and maintain a sustained contact. This obviously is accomplished when penicillin is carried to the middle ear or to the mucous membranes of the nasal accessory sinuses by the hematogenous route, but falls short of this objective when used locally in the nose or throat. It is futile to expect phenomenal results from penicillin sprayed into the nasal cavities. The common head cold is a virus disease for which penicillin is not specific. There is, moreover, considerable proof that the virus is intracellular and the infection submucosal, deeply situated beneath an edematous inflamed mucous membrane. It is inconceivable, therefore, that penicillin sprayed or dusted onto the mucous membrane surfaces can possibly reach the site of infection, even though it might be specific for the offending virus.

Another physiologic factor which seriously militates against a sustained contact between the penicillin and the infecting organisms in the nose is the rapid vibration of mucous membrane cilia. Myriads of these microscopic hairlike structures vibrate at the rate of seven times a second and rapidly carry secretions posteriorly into the pharynx. It is a matter of verity that any substance not possessed of a cauterizing or corrosive action, sprayed or instilled into the nose rapidly makes its escape into the pharynx by ciliary action.

It follows, therefore, that penicillin aerosol is of equivocal value in the nose. It is not specific for the virus of the common head cold and when sprayed or instilled into the nasal cavities, rapidly disappears from the surface secretions. Even if it were present for a sustained period and specific for the organisms which are secondary invaders it could hardly be expected to reach these infections, situated as they are in the deep structures of the nasal mucosa. The secondary infections of acute rhinitis, the significant one of which is acute nasal accessory sinus disease, are not lying on the surface of the schneiderian membrane. They are submucosal, underneath the swollen, inflamed superficial structures and not reached by agents placed upon the surface of mucous membranes. Nothing has happened in my experience to justify a continued interest in this form of therapy.

Apropos of this discussion, it is to be emphasized that when intranasal medication is used, for example a vasoconstrictor, the

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most acceptable method is to introduce the agent by a medicine dropper into each nostril with the patient in the head low position. Cawthorne has demonstrated that thorough coverage of the nasal mucosa with a medicinal agent is best accomplished by the drop method with the subject in the dorsal recumbent position with head hanging backward and downward so that the crown of the head faces the floor. This technique seems to have a distinct advantage over the use of the spray, in that wider dissemination of the medicinal preparation over the nasal mucous membrane is achieved.

We have found little reason to share current enthusiasm in regard to the value of penicillin when used locally in the mouth and throat. In co-operation with our Department of Bacteriology, we have found it possible to reduce the number of organisms in the mouth and pharynx by the use of penicillin lozenges, but the latter have been of little value in the treatment of tonsillitis and pharyngitis. The *Streptococcus viridans* was noticeably affected by this form of therapy and in some instances was practically eliminated from the throat flora. This organism, however, did not seem to be the offender in most instances of acute infection and obviously those that were causing the disorder were either resistant to the penicillin, or not adequately contacted by the lozenge to cause their destruction. It was noted that penicillin, as a rule, could not be demonstrated within the mouth 10 minutes after the disappearance of the lozenge and this was true even when five lozenges were taken in succession within one hour.

It would appear that if penicillin is to be used for mouth and throat infections, we must rely upon its systemic administration. There is plenty of clinical evidence to support the contention that this form of therapy is of distinct value in the treatment of acute follicular tonsillitis, retropharyngeal and peritonsillar infections, acute pharyngitis and Vincent's angina. The local employment of the agent, however, is not dependable. An exception to this rule may be found, perhaps, in the treatment of ulcerative lesions in the mouth by direct application of cotton tampons saturated with penicillin solution, 10,000 to 15,000 units per cc. Some of the mucous membrane lesions of the blood dyscrasias as, for example, the leukemias, have seemed to improve clinically when treated in this manner. A pledget of cotton saturated with penicillin solution is placed in the lingual or buccal sulcus in direct contact with the ulcer and allowed to remain for twenty minutes or longer, four or five times a day. Obviously the effect is not curative but occasionally phenomenal improvement is observed, due, no doubt, to the resolution of the

customary secondary infections. In my experience, this technique of administering penicillin locally is the only one worthy of mention.

Medical as well as lay literature has recently popularized penicillin aerosol for many of the lower respiratory infections, such as bronchitis, whooping cough, bronchiectasis, lung abscess, etc. The results of this form of local administration of penicillin have been most discouraging in our clinic. There is little we can say in its favor. The method has not been effective in the treatment of lung abscess and to date there has been insufficient improvement in our patients with bronchiectasis to place any reliance in this form of therapy. It is to be noted that some of the advocates of penicillin aerosol recommend rather large doses of 15,000 to 30,000 units per cc. of saline solution sprayed into the lower air passages every two or three hours. In a few instances where doses of these proportions have been employed, we have found appreciable blood levels of the antibiotic. We strongly suspect, therefore, that some of the optimistic reports of penicillin aerosol are based on the results of absorption and systemic spread of the antibiotic. It is doubtful that this technique of local application accomplishes more or even so much as the intramuscular injection of the antibiotic. Until certain reservations are dispersed by further studies of penicillin aerosol and somewhat less cumbersome and fatiguing techniques made available for its usage, we have little to offer in its support.

Contrary to this view, however, we find that the local instillation of penicillin into bronchiectatic cavities through the bronchoscope is a measure worthy of consideration. We have seen some examples of phenomenal improvement when penicillin has been used locally in this manner. The bronchiectatic cavity is visualized by direct inspection through the bronchoscope, secretions are aspirated and 2 or 3 cc. of penicillin in saline solution (50,000 units per cc.) are instilled directly into the bronchiectatic cavity. Treatment is employed three times a week until satisfactory improvement is obtained.

The third maxim pertaining to the use of penicillin is one worthy of recognition, namely, that the antibiotic is not effective when used systemically in the treatment of a chronic abscess. The surrounding capsule prevents the penicillin from reaching the localized purulent collection and even when injected for its local effect, the necrotic tissue within the abscess is a deterrent to antibiotic action. It is also true that a foreign body within a circumscribed collection of pus renders the latter resistant to penicillin therapy. Although

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these principles have been known since the National Research Council gave them to the profession several years ago, it is not uncommon to find the physician puzzled by the fact that penicillin has had no effect upon a deep seated chronic abscess in the neck, or upon an osteomyelitis of the cranial bones. Penicillin does not reach an encapsulated abscess deep in the triangles of the neck and it cannot be expected to cure a well established chronic inflammatory process in the bones of the skull. It is true that the antibiotic often appears to arrest the progress of an osteomyelitis or to prevent the spread of a peritonsillar abscess or a case of Ludwig's angina, but these processes, when once established, are not eradicated by this form of therapy. Penicillin may be supportive; when used pre-operatively, it may be expected to prepare the patient for formidable surgical procedures which he might not otherwise tolerate, and when employed postoperatively, it is a well known fact that it tends to prevent the dissemination of infection and thereby reduces the incidence of serious complications.

But to be more specific, I know of no authenticated instance of any of the antibiotics having cured a chronic suppurative otitis media and mastoiditis, or a chronic nasal accessory sinus disease, either when used systemically, locally, or by both methods. In each of these conditions there are factors present which adversely influence the action of the antibiotic. In the chronically infected ear and mastoid we encounter a thickened edematous membrane comparable to the abscess capsule. The tympanum and mastoid cells contain necrotic tissue and the chronic osteomyelitic process frequently gives rise to the sequestration of bone and the foreign body so manifestly deterrent to antibiotic activity.

Similarly, we have comparable pathological changes in chronic nasal accessory sinus disease. The mucous membrane is thickened and polypoid. Scarring is present in varying degrees, necrotic tissue is in evidence throughout the sinus cavity and one frequently finds the lining mucous membrane studded with multiple discrete abscesses which by no stretch of the imagination could be eradicated by penicillin therapy. Moreover, it is not uncommon to note signs of an osteomyelitis beneath the lining mucous membrane, another important factor which militates against the success of the antibiotic therapy.

I freely admit that it is extremely difficult to evaluate accurately and scientifically the results of most therapeutic procedures because of our inability to observe a group of controls. Any experiment of

unassailable scientific accuracy must necessarily call for a series of cases with identical factors of age, resistance, tissue immunity, pathological change, anatomical development, bacterial influence, etc., in which specific therapy is employed in one-half of the group and some other procedure, or no treatment at all, in the remaining half. Obviously, ideal situations of this character do not exist in otolaryngological practice. Nevertheless, over a period of years when the antibiotics have been extensively employed both systemically and locally, our observations lead to the conviction that these forms of therapy have no place in the treatment of chronic suppurative otitis media and mastoiditis, and chronic nasal accessory sinus disease. They do not permit the violation of sound principles of surgery. Operative procedures are imperative if one hopes to obtain a cure, although as already emphasized, penicillin may often be an exceedingly important supportive measure.

Experience in the practice of medicine has frequently led to the observation that penicillin is the vanguard of many therapeutic programs. In otolaryngology it has been employed for everything from nerve deafness and tinnitus to the psychogenic disturbances underlying an hysterical aphonia. I refer to these conditions, not in a facetious sense, but to broach a premise that penicillin employed in a healthy individual may not be devoid of harmful effects. I am frequently consulted by the apprehensive patient who has received a vigorous course of penicillin therapy, because someone discovered a streptococcus in his throat. I need not point out to you that there is nothing abnormal in this finding. It is an organism that one expects to find in nearly everybody's throat. There is a normal basic flora for the upper air passages and the nonhemolytic streptococcus is the chief inhabitant of these regions.

It is a well known fact that the discovery of any particular type of organism in one culture taken from the throat has no clinical significance. In most instances, it is only a representative of normal flora. In other cases it may be just a "hanger-on" that has adapted itself temporarily to the environment of the upper air passages. Again it may be a recent pathogenic offender which is held over in the crypts of the tonsils after the infection for which it is responsible has resolved. Or, in the last category, it may be the agent of an epidemic which has adapted itself to the mucous membrane of the pharynx in some strange manner without producing the reactions for which it is pathogenic. The meningococcus,

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Hemophilus influenzae and the hemolytic streptococcus are often found in the throats of individuals in communities where these infections have been occurring in epidemic form.

Smith and Bloomfield have clearly stated, on the basis of careful studies of cultures taken from the upper air passages of human subjects, that "in order to draw any safe conclusions as to the significance of an organism isolated from the upper air passages, certain technical specifications must be met. The culture should be (a) serial or repeated, (b) quantitative in the sense of some method of plating which gives an idea of the relative numbers of the various organisms isolated and (c) topographical, that is to say, simultaneous swabs should be taken from the pharynx and each tonsil or tonsillar region in order to differentiate local carriage from free growth on the mucous membrane."

But what is of importance clinically is the fact that these observers have discovered that penicillin administered to individuals free from active respiratory infection often changes the normal basic flora of the pharynx. A coliform bacillus frequently appears in the throat during penicillin therapy. In short, changes in "balance of power among the throat flora" may be induced by antibiotics. Specifically, it is altogether possible that under these circumstances one may replace nonpathogenic throat organisms by harmful intruders.

I am convinced that this observation has been made a number of times in my practice. Penicillin employed for some vague throat irritation, often in the patient worried about cancer, has been followed by an acute pharyngitis with general reactive symptoms. In several instances, the mucous membrane of the throat was fiery red, extremely sore, and because it led to the suspicion of some toxic allergic reaction, an order to discontinue penicillin therapy was issued. A return of the pharyngeal mucous membrane to normal promptly occurred. In the light of observations made by Smith and Bloomfield, a logical explanation for this clinical phenomenon seems to have been posed.

In a further discussion of the antibiotics in otolaryngological practice, one must refer to the great value of streptomycin in tuberculous lesions. It seems to have exhibited its superior effectiveness in the treatment of tuberculous adenitis and the mucous membrane lesions produced by the tubercle bacillus. In laryngeal and

trachiobronchial tuberculosis, one gram of streptomycin is administered daily. It is not necessary to maintain a blood level. When employed locally for tuberculous lesions, streptomycin in the nose and larynx has not yielded satisfactory results.

Tuberculosis of the middle ear and mastoid is not a rare observation in an otological clinic and occasionally these conditions are complicated by a tuberculous meningitis. Streptomycin has been used both intramuscularly and intrathecally with effects which are hopeful in a disease otherwise highly fatal. In many cases, approximately 85%, the effect has been only that of an intermission or a remission. Nevertheless, conservative statistics seem to indicate that 15% of the patients are cured and it is hoped that other tuberculocidal substances will soon be found that will add to these numbers. In tuberculous meningitis 50 mg. of streptomycin is administered intrathecally every second day for a period of six weeks or longer. In our experience four patients who have apparently recovered have been profoundly deafened, one of whom has had no auditory sense for a period of two years and consequently is obviously permanently disabled. There can be little justification, however, for assuming that the deafness is a direct result of the intrathecal administration of streptomycin. Tuberculous meningitis is a deadly malady, destructive to nervous tissue, and therefore might well be expected to be directly responsible in itself for the auditory nerve injury. In this connection it is interesting to note that two of the children with profound hearing impairment after recovery from tuberculous meningitis did not receive streptomycin by the intraspinal route.

We have been particularly interested in the effect of streptomycin upon the equilibratory mechanism. As has been noted since the early discovery of this antibiotic, many patients develop vertigo when streptomycin is administered intramuscularly as well as intrathecally. In the course of a few days after the initial dose of streptomycin, one notes that the vestibular responses to the caloric test are diminished. The hypo-activity slowly progresses until the end of the third week of daily therapy, at which time the caloric labyrinthine reactions entirely disappear. It is at this juncture that the patient exhibits vestibular manifestations.

It is significant that the vertigo is not that typically produced by stimulation of the static labyrinth. It is not a true dizziness; not that normally produced when the internal ear is stimulated by

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heat and cold or an electric current. The symptomatology is more in the nature of giddiness or unsteady feeling, an ataxia as it were, and not the true vertiginous seizure that characterizes an end organ stimulation or lesion.

As might be surmised, pathological studies of the internal ear fail to demonstrate that streptomycin exerts its toxic effects upon the end organ. Ménière's disease which is due to a labyrinthine hydrops and is characterized by violent attacks of dizziness is the classic example of a lesion within the internal ear. Pathologic studies of the otic labyrinth have failed to indicate any changes which might be attributed to the neurotoxic effects of streptomycin. We do not know precisely the location of the pathological change produced by this antibiotic, although we suspect that it must be situated somewhere in the basal nuclei or along the corticobulbar fibers of the auditory nerve.

The catalytic hydrogenation of streptomycin has produced an antibiotic, dihydrostreptomycin, which appears to be approximately 70% less neurotoxic than the original preparation. In our hospital it has largely replaced the latter agent for parenteral administration because it can be given in larger doses, two grams daily, with little or no effect upon the auditory and equilibratory mechanisms. It is not advocated, however, for intrathecal use because it is irritating to the meninges and therefore less satisfactory for intraspinal injection than streptomycin. With improved methods of purification it is hoped that this disadvantage may soon be overcome.

In recent cases of tuberculous meningitis, dihydrostreptomycin has been employed intramuscularly and streptomycin intrathecally with encouraging results. The resistance of organisms to both preparations when used for long periods seems to be manifest to an equal degree. It has been noted that when two grams of streptomycin is administered systemically for 125 days, 75% of the patients will demonstrate resistant organisms. If, however, only one gram is employed daily for a period of 42 days, this percentage is reduced to 25%. In those cases of mucous membrane tuberculous lesions which have come under our observation, we have endeavored to gain this advantage by using the minimum dose of one gram daily for a period not to exceed six weeks.

CONCLUSIONS

1. Nearly all the acute infections of the ears, nose, sinuses and throat respond in a gratifying manner to the parenteral administration of penicillin. The isolation and identification of the causative organisms in every case of infection is an idealistic pronouncement but hardly feasible and practicable in every day practice. When, however, a definite clinical response to the antibiotic is not promptly observed, the organism must be identified and its sensitivity determined. No other course will permit the rationalization of specific therapy.

2. When dealing with meningitis where time is an essential factor, delay for the identification of the organism can hardly be advocated. There can be no compromise with the prompt institution of therapy. Antibiotics of proven values, penicillin, streptomycin and even aureomycin or chloromycetin, particularly the latter, when an intracellular infection is suspected should be employed in maximum dosage in conjunction with chemotherapy. It goes without saying, however, that some of these agents will be eliminated in favor of the specific antibiotic when the causative organism is subsequently discovered and its sensitivity determined.

3. Penicillin, to be effective, must come in actual contact with the organism and maintain a sustained contact. The difficulty of applying this principle to the upper air passages is accountable, perhaps, for the disappointing results observed from the popular methods of topical administration. Penicillin aerosol is of little value in the treatment of bronchiectasis, although the direct application of concentrated solutions of penicillin to the bronchiectatic cavities through the bronchoscope has been productive of encouraging results.

4. A dense capsule surrounding a chronic abscess in the neck is a barrier to penicillin therapy. Likewise, necrotic tissue or a foreign body within the abscess renders the lesion resistant to the antibiotic. Similar factors which influence adversely the effectiveness of penicillin are found in chronic suppurative otitis media and mastoiditis, osteomyelitis of the calvarium and facial bones, and chronic nasal accessory sinus disease. These pathological entities are not cured by any antibiotic in our present therapeutic armamentarium, either when used systemically, locally or by both methods.

ANTIBIOTICS

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5. An admonition seems timely in regard to the possible injurious effects of penicillin in the absence of infection. The normal basic flora of the throat may be altered to include harmful organisms. It is to be emphasized also that the prolonged administration of the antibiotic may produce resistant organisms which fail to respond to penicillin therapy at some subsequent time when the antibiotic is sorely needed. We have a staff member under our observation today who has received intensive penicillin therapy for a chronic maxillary sinusitis. The treatment has been futile. More perturbing, however, is the fact that he harbors a pneumococcus in his antrum which is resistant to penicillin. This raises the question, has this patient lost an important defense against the possible future development of pneumococcal complication?

6. Streptomycin is particularly effective in tuberculous cervical adenitis and in tuberculous mucous membrane lesions. It is highly probable that its allied agent, dihydrostreptomycin, which is comparatively free from neurotoxic effects, will replace the original antibiotic in the treatment of these conditions. Until further experimentation yields an improved product devoid of irritating effects, dihydrostreptomycin cannot be advocated for intrathecal administration.

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II

DIAGNOSIS OF MALIGNANCY OF THE NASOPHARYNX.
CYTOLOGICAL STUDIES BY THE SMEAR TECHNIC

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AND

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The results of the cytological studies for diagnosis of nasopharyngeal malignancy by the smear technic are excellent. The procedure is not offered as a substitute for histopathological diagnosis from biopsy material but is recommended as an adjunct means of arriving at a diagnosis. The technic is not difficult but is exacting. A negative smear does not eliminate the possibility of a nonexfoliating lesion. A positive smear signifies the presence of an exfoliating lesion in the upper respiratory tract. It is then mandatory that the origin of the cells be found, the area biopsied and the final diagnosis made from the tissue. Thus far no false positive smears have been found. Such limiting factors as are present will be brought up under subsequent headings.

The nasopharynx has maintained a fair degree of interest throughout modern literature. The amount of this interest has varied with the contributions and the contributors. The recent wave of increased attention to this area is the direct result of the numerous contributions emphasizing the importance of hypertrophic and hyperplastic lymphoid tissue in, on and about the eustachian orifice. As a result of this widespread information, attention has been redirected to the area and tumors and malignancies of the nasopharynx have regained importance as subject matter. No one can review the literature on this subject without being impressed by the fact that all contributors agree on two points: the importance of early diagnosis and the difficulty in making an early diagnosis.

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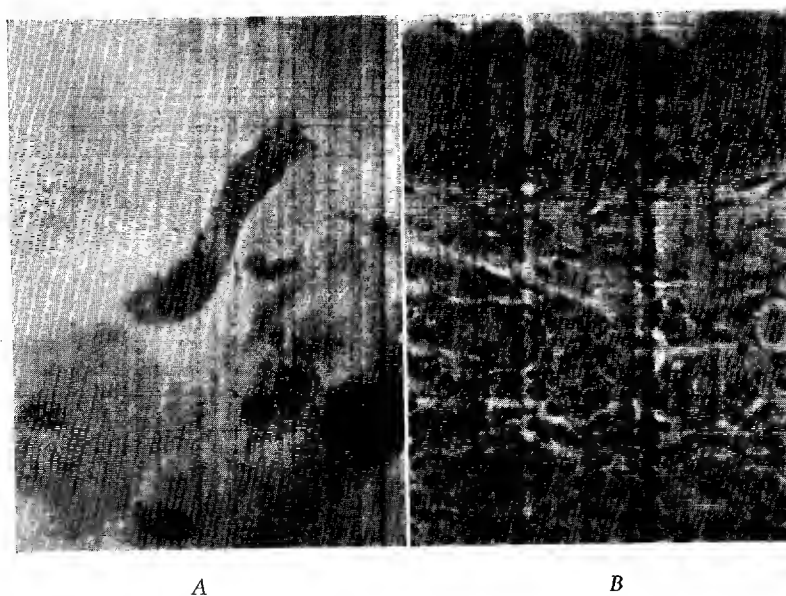


Fig. 1.—R.V., white female, aged 51. Complaint: Difficulty with breathing through nose for over one year, tingling in left side of tongue and palate for several months and paralysis of left external rectus muscle of three weeks' duration. A. Smear showing normal cellular elements: a ciliated columnar cell, a lymphocyte and squamous epithelial cells. B. Biopsy. The surface mucous membrane is intact. This fact accounts for the negative smear. There is no opportunity for exfoliation of malignant cells. Diagnosis: Cylindroma.

The first point needs no elaboration. The general consensus of opinion explaining the second point is summarized as follows:

1. The initial lesion is usually small.
2. The condition is usually asymptomatic until metastases occur.
3. The first symptoms frequently are referred to some other structure such as the neck, eye or ear.
4. The area is not as accessible for examination as are most of the other structures of the nose and throat. Many otorhinolaryngologists do not make the examination of the nasopharynx a necessary part of their routine examination.

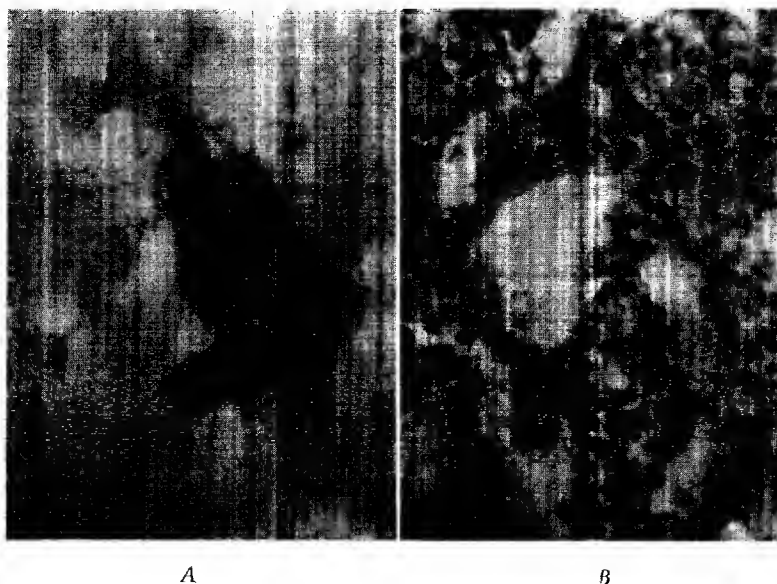


Fig. 2.—E. S., white female, aged 62. Complaint: Severe epistaxis. History of right nasal obstruction of several months' duration. A. Smear showing group of malignant cells. B. Biopsy. Diagnosis: Adenocarcinoma.

5. The variations in the appearance of the islands or masses of lymphoid tissue in the nasopharynx that may be considered "within the limits of normal" are greater than in other areas of the upper respiratory tract.

6. It is difficult to obtain satisfactory and representative biopsy specimens.

Such unanimity of opinion warrants attention. The various credited ways and means of examining the nasopharynx and the methods of evaluating the findings were reviewed and discussed in detail. Each had advantages and disadvantages. All were found lacking on one important point: negative findings did not rule out the possibility of the presence of an unobserved malignancy. The suggestion that the smear technic might have something to offer was presented. The present available literature had nothing to offer on this subject.

The interest in the application of the excellent results obtained by the smear technic as reported by Papanicolaou and Traut¹ in detecting cancer cells in vaginal secretions to secretions from other areas

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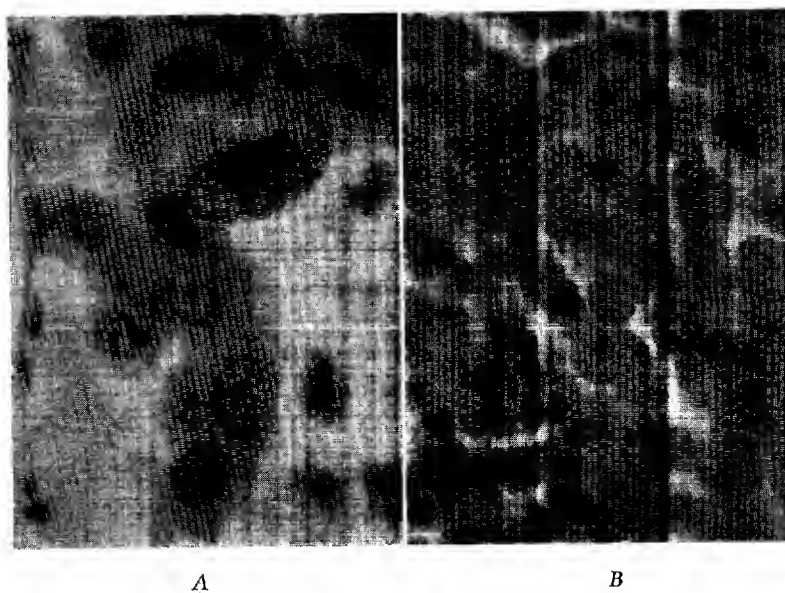


Fig. 3.—J. G. R., white male, aged 52. Complaint: Increasing obstruction of the right side of the nose of one year's duration. The right ear has felt "stopped-up" for several months. A. Smear showing the large number of malignant cells sometimes found in a single field. B. Biopsy. There is marked similarity between the appearance of the cells in the fixed tissue preparation and those in the smear. Diagnosis: Lymphoepithelioma.

had reached a point of justified enthusiasm. The examination of bronchial secretions had proved its value in the diagnosis of early bronchogenic malignancies. It was logical to assume that a similar technic could be used as an adjunct measure in the diagnosis of exfoliative lesions in the nasopharynx. The literature on the subject of the recognition of cancer cells in body secretions is emphatic on several points. One of the more important points is the necessity of exact knowledge of the normal cellular content of the secretions from a definite area. This means not only the ability to recognize and classify the cells in their adult prime state but also in the varying stages of senility and disintegration. This is a time-consuming bit of exacting work but is essential, fundamental background.

No progress could be made until the normal cell content of the secretion of the nasopharynx had been established. The normal histology of the area is well known. A brief résumé of this knowledge shows that with the exception of a few areas the mucous mem-

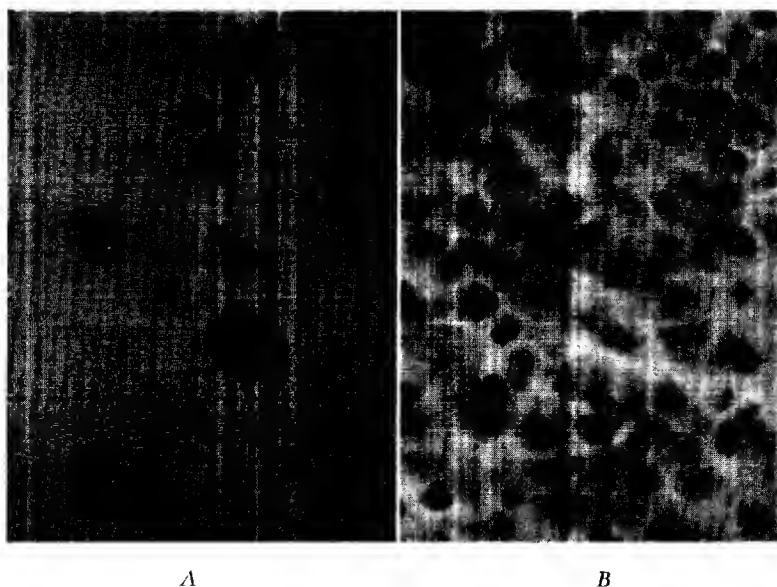


Fig. 4.—J. S., Negro male, aged 37. Complaint: Right frontal and temporal headache and diplopia of four months' duration. A. Smear shows variation in size and shape of malignant cells. B. Biopsy. Diagnosis: Lymphoepithelioma.

brane that covers the nasopharynx is composed of a layer of pseudo-stratified, ciliated, columnar epithelium. The apparent stratification is due to the fact that the cell nuclei are distributed in several planes. In the corium, beneath the surface epithelium, are numerous closed lymphoid follicles. At the junction of the nasopharynx and oropharynx there is a distinct change in the surface epithelium. A characteristic of the latter area is that the surface cells are no longer ciliated and are typically squamous. This knowledge offered a starting point for orientation as to the origin and type of cells one would consider normal constituents in the secretions of the nasopharynx (Fig. 1).

It was realized that the whole project might bog down if the activities were confined wholly to obtaining a knowledge of the normal cell population of the nasopharyngeal secretions. In order to alleviate some of the drudgery phase, obtain peak enthusiasm and at the same time have some basis for a check on the results, the smear technic was applied to visible lesions of the mouth, tonsils and larynx.

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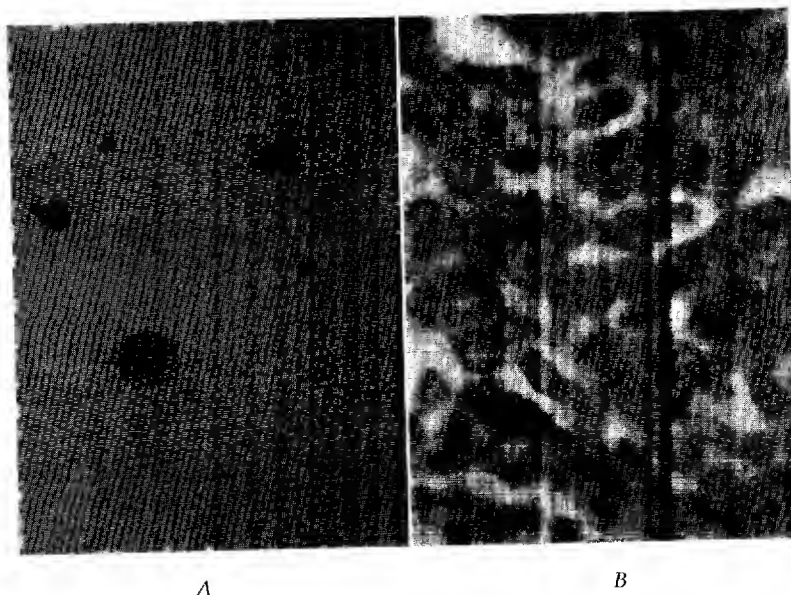


Fig. 5.—H. T. G., Chinese male, aged 26. Complaint: Swellings in neck for several weeks. A. Smear showing a single malignant cell and a nearby polymorphonuclear leucocyte. There are several other fields that show a similar picture. None of the fields showed any grouping or clumping of the malignant cells. B. Biopsy. Diagnosis: Transitional cell carcinoma.

The suggestion obtained the desired results as far as the interest factor was concerned and in addition produced some findings that are worthy of consideration. These findings are presented in Table 1.

TABLE 1.

Source of material	Mouth	Tonsil	Larynx
Number of cases examined	22	16	15
Positive smear	10	7	8
Negative smear	12	9	6
False positive (Positive smear, negative biopsy)	0	0	0
False negative (Negative smear, positive biopsy)	0	0	1
Positive biopsy	10	7	9

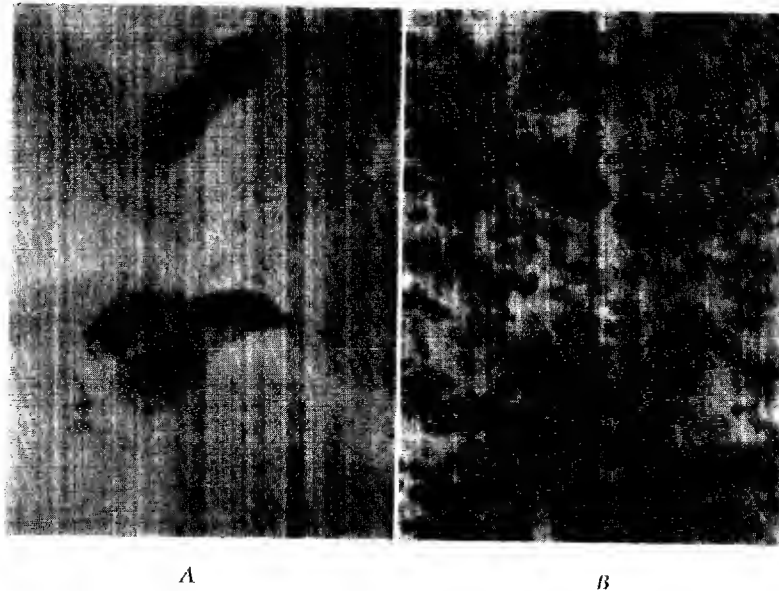


Fig. 6.—K C. C., white female, aged 4. Complaint: Sent into hospital with diagnosis of question of cavernous sinus thrombosis as a complication of left pansinusitis. The "sinusitis" had been treated for three months with several courses of various sulfa compounds and antibiotics. A. Smear showing malignant cells and a multinucleated giant cell. B. Biopsy. Diagnosis: Adenocarcinoma.

The one false negative report (negative smear with positive biopsy report) is readily explained by the fact that the laryngeal lesion, although somewhat extensive, was of the so-called intramucosal type. There was no evidence of ulceration or abnormal appearance other than smooth enlargement of the involved area. The biopsy specimen showed an intact, normal appearing epithelial surface. The unmistakable malignant cells were in and beneath the submucosa. Under these conditions one would not expect to find exfoliated malignant cells. This case did attest to the veracity of the investigators. The visible clinical evidence of the malignancy of the lesion in situ was classical. With these findings and the least bit of wishful thinking it would have been a simple matter to find one or two slightly atypical normal cells that would have justified a plus-minus or suspiciously positive report from the examination of the smear. It was not until several days later when the stained paraffin sections of the biopsy material were available that a positive diagnosis of malignancy was made. In retrospect it is evident that one step was

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omitted. After the biopsy material had been obtained a smear should have been made from the raw surface of either the specimen or the area from which the specimen had been removed. This can be done without injury to either the specimen or the patient. This was done in two later cases, one nasopharyngeal tumor and one tumor of the hard palate, and produced excellent results.

Technic. No attempt to obtain secretions from the nasopharynx is made until the routine examination of the ears, nose and throat is completed and the findings noted. When this is completed the nose mucous membrane is shrunk and anesthetized. The topical application of a 2% solution of Pontocaine with one drop of 1:1000 adrenaline solution to each applicator is used for this purpose. The use of adrenaline or epinephrine solution as a shrinking agent is not permitted for routine decongestion purposes. However, the vigorous action of these agents is necessary for detailed examination of the nasopharynx. The advantages are sufficient to negate the immediate and secondary reactions that may follow their use. In some instances a variation in reaction to the usual blanching effect is in itself grounds for suspicion as to the normalcy of the differentiated area. In a very few minutes one is able to obtain a surprisingly good view of the nasopharynx through one or both nares. Before any smears are taken, the nasopharynx is thoroughly examined by means of both the posterior rhinoscopic mirror and the nasopharyngoscope. When these examinations are complete a tightly wound cotton tipped applicator is passed directly to the nasopharynx through the anterior naris. In order to be certain that both representative and adequate material be obtained, the cotton must rub on the surface of the nasopharyngeal mucosa and should preferably contact as much of the nasopharynx as is possible. One's endeavors to obtain representative surface cells should not permit tissue damage. A few red cells in the smear may be commendable. Active bleeding is conclusive evidence of poor technic. Following the removal of the applicator the smears are made by gently rubbing the obtained secretions on a clean, dry slide. The slides are immediately immersed in the fixative solution consisting of equal parts of 95% ethyl alcohol and ethyl ether. The staining technic follows the modified method of Papanicolaou and Traut² used in the Vincent Laboratory, Massachusetts General Hospital, with but one exception, in step No. 6, EA50 replaces EA36 or 25.

Microscopic Findings—Normal. A knowledge of the histology of the area offers a foundation for the kinds of cells one would expect to find as normal constituents of the secretions from that area. One

point should be considered before a description of the cell population is presented. The exfoliated cells will all be adult, past their prime and many will show evidence of lytic or autolytic change. Even when one has been more vigorous than necessary in swabbing the area with the cotton tipped applicator only adult cells will be obtained. In general, the exfoliated cells are larger than the same type of cell when it is functional and in the relatively crowded normal surroundings. With this knowledge as a background, one would expect to find, and does find, in the smears from the nasopharynx numerous ciliated columnar cells, columnar cells which have lost their cilia, lymphocytes, polymorphonuclear leucocytes and occasional clasmatocytes or tissue macrophages. These tissue macrophages can readily be confused with malignant cells due to their characteristic variation in size and shape. In addition, one commonly finds squamous epithelial cells, bacteria, and erythrocytes. The presence of erythrocytes in the normal smear is the direct result of trauma caused by the cotton tipped applicator. The normal columnar cells usually present a clear cytoplasm. One common variation is the foamy or globular cytoplasm encountered normally during the secreting phase of the goblet cell. The nuclei vary as to size, shape and position in the cell. They are relatively large, oval in shape, and contain distinct nucleoli. The chromatin content is evenly distributed as fine granules. The nuclear wall is distinct but not thickened or irregular. A description of the characteristics of the cells that permit classifying a smear as "positive" is of no value to anyone who is not familiar with the cell content of the secretions obtained from the average, routine, so-called normal nasopharynx.

Microscopic Findings—Malignant. The cell nucleus, rather than the cytoplasm, presents the characteristics that permit the cell to be classified as malignant. A brief outline of these characteristics presents only the outstanding points of differentiation from the normal. An enlarged nucleus and nucleolus with abnormal chromatin content are significant. The eccentric position of the chromatin simulates a thickened nuclear membrane. The enlarged nucleoli may appear eosinophilic. These nuclei are frequently surrounded by a small amount of cytoplasm. The cell wall is often distorted, indistinct or absent. The presence of clumps of these cells is most significant (Fig. 3). The outlining of the differentiating characteristics in this simple way is disarming to only the novice who, in his present status, should be permitted the assumption that the opportunity for confusing distorted normal cells with the characteristic malignant one is unlikely. Such confusion is not only a possibility but a probability in poorly prepared, fixed or stained smears.

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Practical Application of the Method. The number of patients with tumors of the nasopharynx available for study at any one period of time is never large. We were fortunate on two scores, first, there was a small backlog of post-radiation patients who had concluded their therapy at periods of time ranging from a few months to ten years; second, among the number of patients who reported for one reason or another eight were found to have malignant lesions in the nasopharynx. Not an overwhelming number, to be sure, but sufficient for establishing the validity of the method. The results are presented in Table 2.

TABLE 2.

NASOPHARYNGEAL SMEARS

Number of cases examined	85
Positive smear	7
Negative smear	77
False positive (Positive smear, negative biopsy)	0*
False negative (Negative smear, positive biopsy)	1
Positive biopsy	8

*In one instance the persistence of a positive smear encouraged repeated biopsy. The fifth biopsy showed anaplastic carcinoma.

In this series as was the case in those presented in Table 1, there is a surprising agreement between the smear technic and the histopathological diagnosis. The one false negative warrants elaboration. The patient presented definite evidence of an extensive lesion in the nasopharynx as demonstrated by paralysis of the left sixth nerve, diminished hearing in the left ear (conduction type with a serous otitis media), roentgen evidence of extensive destruction of the base of the skull, and a visible tumor in the left nasopharynx. It was a moderately rounded mass occupying about one-third of the available space of the left nasopharynx and arose from the vault and posterior wall. It was covered with normal appearing mucous membrane. There was no evidence of ulceration or breakdown. The tumor mass was readily visualized by posterior rhinoscopy. The histopathological picture verified the fact that the surface covering was normal and intact. The neoplasm was a typical cylindroma. Naturally there would be no exfoliation of malignant cells.

Two post-radiation patients are included in the group of negative smears. One has been symptom free for ten years and the other for eleven years following extensive courses of deep x-ray therapy. Both have a dry or relatively dry nasopharynx and one has an area on the upper posterior pharyngeal wall about 1.5 cm. in diameter that acts as a site for crusting. This area corresponds to the location of the neoplasm prior to treatment. It is almost twice the size of the visible portion of the neoplasm when the original biopsy was done. It is of interest that smears from both these patients showed a preponderance of squamous cells and no ciliated, columnar cells.

DISCUSSION

The available literature dealing with the application of the smear technic for diagnosis of exfoliating lesions in the upper respiratory tract was reviewed in the hope that some one had preceded us in using the method for lesions in the nasopharynx. We found no mention of its having been used in this area. Several of the more recent articles and especially those dealing with the findings obtained from sputum brought up points that are entitled to limited discussion prior to confining our thoughts to the nasopharynx.

Formal and informal discussions of the validity of the method and the veracity of the investigators employing the smear technic leave no question but that there are some who would deny both. A recent article³ contains two statements in the introductory paragraphs that may be used to substantiate this view. The first statement reads in part: "It is necessary also that the pathologist have no knowledge of the clinical status or even the age of the patient." The second statement, also in part, reads: "All of the interpretations were made by a single observer on the basis of numbered slides, with no inkling of the clinical nature of the case." It so happened in our series of cases that the report on the smears was available one to three days before the fixed tissue slides were stained and mounted. This was not the result of any forethought on our part; it just happened that way. All three of us saw all of the cases and freely discussed the clinical picture prior to obtaining the smears and biopsy material. The entire responsibility of preparing, staining and scanning the smear preparations fell to the lot of Dr. Wu. The two false negative cases and the one case wherein five biopsies were required to rule out a false positive report offered ample opportunity for permitting slight deviations in the cell population to be classified one way or the other, depending on the clinical findings and the mental attitude of the investigators, were it not for the fact that the negative smears contained only cells that were normal or variants of normal, and

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the positive smear contained unmistakably malignant cells. This left no opportunity to report findings according to one's clinical impressions nor did it permit a plus-minus report. A sufficient number of slides can be and should be made at the time the material is obtained so that careful search will give a true picture of the cell content. Additional time spent in searching these slides will usually permit a direct answer of positive or negative. If, after diligent search, there is any question, no answer should be offered until additional material has been obtained and examined. It is a gross waste of time and effort to attempt to draw any conclusion from slides that are improperly prepared, fixed or stained. The examination of the stained smears is a painstaking, time-consuming task that must be carried out in an orderly manner. The criteria are exact and the work is exacting. The smear technic is not a simple procedure to be put in the same category as routine blood and urine examinations. Fortunately the time factor essential for the present accepted technical steps has been sufficient to discourage the usual commercial laboratory from attempting to popularize the procedure.

The idea of a cloistered automaton to whom slides will be given and from whom correct answers will be received is appealing as a means of saving the clinician's time for other work. Even if such a creature were obtainable it is illogical to assume or expect this disinterested party to obtain and maintain the meticulous attention to detail essential for satisfactory results. Without the interest factor the detailed search through innumerable slides becomes a dreary task. There are few institutions that can afford to underwrite such a program. The suggestion that trained technicians could be used has been proposed, employed and found satisfactory to a degree. A well trained technician can be of great help in screening out the unquestioned negatives. The final answer should come from a source of authority. The responsibility that accompanies a positive or negative answer is not a light one.

A positive smear obtained from the secretions removed from the nasopharynx does not necessarily mean that the exfoliating lesion is within the confines of the nasopharynx. A moment's reflection on the normal physiology of the upper respiratory tract reminds one that all of the secretions from the paranasal sinuses and nasal mucous membrane pass over the nasopharynx. Many pertinent facts may be obtained from the text by Proetz.⁴ In the chapter on ciliary action one finds a short paragraph following some figures on the speed of the streams of the mucous blanket that reads: "The significant conclusions to be derived from these figures, are, namely, that a sinus with its full complement of cilia can renew its mucous coating in

the short space of some five or ten minutes and that the entire nasal blanket is discarded into the pharynx at the rate of at least once every half hour!" The facts allow the assumption that malignant cells found in smears made from secretions obtained from the nasopharynx might have their origin in the nose or the accessory sinuses. Fortune favored us in being able to prove the correctness of this assumption. A patient who had had a biopsy of a neoplastic mass in the right middle meatus some seven days previously was sent to the middle meatus biopsied some seven days previously was sent to the clinic for consultation as to further advice for handling the problem. The presenting surface of the biopsied mass was covered with a superficially dry, bloody, disintegrating crust. Smears were taken from the right posterior choana and the nasopharynx. After this material was obtained the crust was removed. Smears were made from the under surface of the crust and from the then raw surface of the neoplasm. Past experience has shown that smears from the moist or contact surfaces of crusts are of little value in that such cells as are identifiable have undergone lytic action and have lost the differentiating characteristics. The experience of the past was repeated in this case. Smears made from the raw bleeding surface of the neoplasm did contain some malignant cells but the fields were crowded with red cells and debris. The smear from the secretions from the floor of the nose and nasopharynx were strongly positive. It is noteworthy that the exfoliated malignant cells were in an excellent state of preservation. These findings permit repeating the injunction that the finding of malignant cells in the material obtained from the nasopharynx makes it mandatory that the source of those cells be found (Fig. 2).

The source of these cells may be in any area from which the mucous blanket comes. The speed of flow of the mucous stream permits that source to be at any remote part of the upper respiratory tract. There are no reasons for assuming that malignant cells found in the nasopharynx would come from any area other than the upper respiratory tract. The probability of diagnosing very early neoplasms in the sinuses is open for speculation. The known limiting factors are, first, that the neoplasm be of the type that exfoliates; second, the dilution factor; and third, the presence of signs or symptoms of sufficient importance to direct the examiner's attention to the necessity or advisability of examining the nasal or nasopharyngeal secretions by the smear method. We have no illusions in regard to advocating the employment of the smear technic as one of the steps in the routine nose and throat examination.

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We are sufficiently satisfied with the results presented to recommend the examination of the nasopharyngeal secretions as an adjunct in the diagnosis of exfoliating malignant neoplasms to anyone equipped to carry out the necessary technical steps. Unfortunately we are not able to offer any improvements in the technic of staining the smears nor any speed-up method as a substitute for the laborious field by field examination of the stained smears. We are confident that the method will maintain a high degree of accuracy in the hands of those who will spend the time necessary to obtain a knowledge of the normal cytology and its variations before attempting to recognize the abnormal. We feel equally confident that the method will be of little or no value if the examination of the stained smears is turned over to a disinterested observer, no matter how well trained this observer may be.

SUMMARY

1. The results obtained by the smear technic are excellent.
2. It is not a substitute for biopsy.
3. It is an excellent adjunct in the diagnosis of exfoliating neoplasms and has shown itself to be so reliable that a positive smear demands the finding of the source of the malignant cells.
4. A knowledge of the normal cytology of the area is a prerequisite that cannot be evaded.
5. It is a time-consuming procedure that demands meticulous attention to detail. This is one reason why it will not become a routine laboratory procedure on a level with blood counts and urinalysis.
6. Accurate diagnosis can only be made by a cytologist familiar with the area. A well trained technician can be used to screen out the unquestionably negative slides.
7. The method has nothing to offer the casual observer.

We wish to express our gratitude to Doctor Herbert F. Traut for permission to use the facilities and materials of the Cytology Laboratory, Division of Obstetrics and Gynecology, University of California Medical School, San Francisco, California.

UNIVERSITY OF CALIFORNIA MEDICAL SCHOOL.

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III

THE RELATION BETWEEN HEARING LOSS FOR SPECIFIC FREQUENCIES AND THE DISTANCE AT WHICH SPEECH CAN BE IDENTIFIED

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URBANA, ILL.

The general effort of this introductory study has been an attempt to determine the relative contribution made by individual frequencies to the identification of the spoken voice. This is, of course, a very broad general problem of speech intelligibility, many aspects of which have been studied by previous investigators. Much of the work of Fletcher¹ was devoted to this problem. Fowler,² Steinberg and Gardner,³ Bunch,⁴ Beasley,⁵ Harris,⁶ Goldman,⁷ MacFarlan⁸ and Hughson and Thompson⁹ have all reported on various aspects of the relationship between audiograms and speech intelligibility.

The present study is intended to amplify these previous works by supplying certain statistical relationships between individual frequencies and the spoken speech score. It has been the specific purpose of these statistical procedures to examine the relation between the two measures: (1) air conduction and bone conduction loss in decibels for the individual frequencies 256, 512, 1024 and 2048, and (2) the distance measured in feet at which the spoken digits could be identified. This study deals for the most part with the relationships of individual frequencies to the total speech score. Most previous studies have been concerned with the relation of an averaged decibel loss from selected frequencies of the audiogram.

Results are presented of a statistical study of the product-moment correlation between hearing loss in decibels for specific audiogram frequencies and the distance at which digits spoken by an adult male voice could be identified. Clinical data including tests of 156 ears were obtained from the files of the Speech and Hearing Clinic of the University of Washington, Seattle, Washington. The cases represent the whole range of hearing-case-types usually presented at a university speech and hearing clinic. The

individuals were from the following groups: (1) graduate and undergraduate students of the University of Washington, (2) students referred to the University Speech and Hearing Clinic from the grade schools, junior high and senior high schools of Seattle, (3) individuals referred to the University Clinic by the Veterans' Rehabilitation Administration offices in Seattle, (4) individuals referred to the University Clinic by physicians and otological specialists of the Seattle and nearby area, (5) individuals referred by various hearing aid dealers of the State of Washington, and (6) individuals of the general public who presented themselves at the University Clinic for testing and retraining services.

All hearing loss cases on which the complete data necessary for this study was available were included in the statistical analysis. The types of hearing loss represented by the cases of the study are, for the most part, covered by the descriptive term "mixed loss". No effort has been made to separate the cases into conduction and perception types. The age range is 16-72 years.

Part of the standard procedure for testing hearing at the Speech and Hearing Clinic of the University of Washington (during the academic year 1947-48) included the speech-whisper test as well as audiometer tests for all individuals of suitable age. These were but two of a group of diagnostic examinations which were administered according to the indication of the individual case.

The speech and whisper test was in all instances administered by the same person. The voice used for the test was that of an adult male, age 35; the average pitch level of the voice had been previously determined to be 131 cycles. The test was always administered in a room whose dimensions were 22 ft. by 16 ft. with a ceiling eight feet above the floor. The surface of the ceiling was treated with Acoustitex tile.

The speech-whisper test is completely described by Fletcher.¹⁰ Briefly, in the method used in this study, the tester pronounced digits while moving slowly away from the subject. The score for the test was the greatest distance (in feet) at which the patient could identify the digits presented. In the procedure described by Fletcher, the score for the test was the distance where the subject just fails to identify the digits. It was our opinion that the determination of the point where digits were identified was a more specific procedure than the determination of the point where digits

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could not be identified. Therefore, the present procedure differs from Fletcher's in this respect.

Subjects were chosen because they showed no response to the "average whisper" at a distance of one inch. That is to say they responded to the spoken voice at distances between one inch and twenty feet.

The audiometers used were a Sonotone Model 20 and an ADC Model 50E. These were calibrated at the outset. Their adjustment was checked once a week against the known hearing curves of two individuals during the periods of the collection of the data. The audiograms secured during the checking process did not in any instance deviate more than 5 decibels from the original audiogram. It was felt that the audiometers remained in essential calibration during the period of testing.

The hearing loss in decibels for air conduction at the frequencies 256, 512, 1024 and 2048 was correlated against the speech score in feet by the product-moment correlation coefficient according to the statistical method described by Edwards.¹¹ Coefficients were also determined for bone conduction losses at the same frequencies and correlated with the speech score.

The figure for the American Medical Association percentage hearing loss was determined according to the directions given by the American Medical Association.¹² This percentage loss was then correlated with the speech score by the method cited above.

The average audiometric loss was computed by averaging the decibel loss values for 512, 1024 and 2048 cycles and multiplying by 0.8, according to Bell.¹³ This averaged loss was then also correlated with the speech score by the same method. The statistical analysis of the results of this study is presented in the accompanying table.

The statistical analysis in general indicates that there is a relatively low positive degree of association between the two quantities correlated: (1) the hearing loss (either by air conduction or by bone conduction) for one of the specific frequencies calculated and (2) the distance at which digits can be identified by the subject with reduced audition.

Column I lists the specific individual frequencies and averaged frequency values (both for average decibel loss and AMA% loss) which were correlated with the speech score.

TABLE
STATISTICAL ANALYSIS OF RESULTS

I	II	III	IV	V	VI	VII	VIII	IX
Hearing Loss at Frequency	AC or BC	Product- Moment "r"	Significant at 1% Level	Significant at 5% Level	Standard Error	Variance Explained by "r"	Variance Unexplained by "r"	Qualitative Evaluation of Association
256	AC BC	.315 .241	Yes Yes	Yes Yes	.072 .075	.099 .058	.901 .942	Very low, positive Very low, positive
512	AC BC	.525 .427	Yes Yes	Yes Yes	.056 .064	.275 .182	.725 .818	Low, positive Very low, positive
1024	AC BC	.419 .300	Yes Yes	Yes Yes	.066 .072	.175 .090	.825 .910	Very low, positive Very low, positive
2048	AC BC	.043 .011	No No	No No	.090 .090	.002 .001	.998 .999	
Average Db. Loss: 512, 1024, 2048	AC	.467	Yes	Yes	.062	.218	.782	Low, positive
AMA % Hearing Loss	AC	.074	No	No	.079	.005	.995	

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Column II indicates whether the "r" was computed for the air conduction or bone conduction loss.

Column III lists the calculated correlation coefficient obtained by the product-moment correlation method described by Edwards.¹⁴ It will be seen that the obtained "r" values range from a low of .011 for 2048 BC to a high of .525 for 512 AC.

Column IV indicates whether or not the obtained "r" is significant at the 1% level. That is, we can say with statistically great certainty that there is a degree of association between the calculations of our study for which the "r" is significant at the 1% level. In the values of this study the degree of association indicated is usually low. But in seven of the ten correlations the association is highly significant at the 1% level.

Column V indicates whether or not the obtained "r" is statistically significant at the 5% level. It so happens that all correlations of this study were either highly significant at the 1% level or were not significant at all. Those "r" values which did not indicate a statistical significance were those for the correlations 2048 AC, 2048 BC and AMA % hearing loss. We should interpret our statistical results to mean that the nonsignificant value obtained is a suggestion that it is not reasonably certain that these three particular correlations may not have been made for quantities which were unrelated linearly.

Column VI lists the standard error for each "r" for those who may wish to examine the results further.

Column VII lists the statistical value of the variance of these two correlated quantities which is explained by the correlation coefficient "r". The variance explained is uniformly low, varying from .001 for 2048 BC to .275 for 512 AC.

Column VIII indicates the statistical value of the variance of these two correlated quantities which is not explained by the calculated "r". These values of unexplained variance vary between .725 for 512 AC and .999 for 2048 BC.

Column IX lists the relation between the two quantities correlated. For the seven values of the study for which a degree of association was indicated, the qualitative evaluation given by Edwards¹⁵ is shown. The correlations for 512 AC and average decibel

loss indicate a statistically "low" degree of association. Correlations for 256 AC, 256 BC, 512 BC, 1024 AC, 1024 BC indicate a statistically "very low" degree of association for the two quantities of our study. For the correlations 2048 AC, 2048 BC and AMA % hearing loss we cannot be certain that there is any degree of association at all.

It will be seen that the "r" value at each frequency uniformly indicates a higher degree of association for the air conduction correlation than for the bone conduction correlation. Such a greater association for the air conduction score than for the bone conduction loss may well be in accord with the usual audiometricians view that the tests for air conduction give greater testing efficiency than do the present bone conduction testing methods.

SUMMARY

It should be remembered that the results presented here are for a specific group of cases, in a specific testing room, with a particular speaking voice. We might well expect that we would change our results with a change in any of the factors indicated. However, within the limits of this study, every effort has been made to control the factors of testing voice, audiometer variation, and concise instructions to the subjects tested.

At least for the 156 ears of this study the individual audiometer frequency values (either air conduction or bone conduction) for decibel loss indicate little statistical association with the spoken speech score. The correlation for the American Medical Association percentage hearing loss indicates it is not statistically certain that there was any degree of association with the spoken speech score.

This present study has confined itself to a correlation of the score for spoken digits. The correlation for the whisper scores is now under study. It is possible that, if these hearing loss cases were separated into various loss types, some greater degree of association might be demonstrated for the quantities of this study. Experiments in this vein are now in progress.

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IV

TANTALUM IN RHINOPLASTIC SURGERY

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For many years surgeons have sought an implant for building up tissue defects, especially that known as "saddle-nose". The large variety and number of substances thus used suggest that none has been entirely satisfactory.

In 1900, Nelaton¹ introduced autoplasmic cartilage, and this has withstood the test of time better than any other substance thus far used. In the same year, Gersuny² introduced vaselin as an implant, while in 1901 Eckstein² suggested paraffin. Soon afterwards, combinations of the two were tried, with the results known to all of us. The immediate cosmetic results of such injections of vaselin and/or paraffin were good, but almost invariably there was subsequent inflammation with abscess formation and ulceration at the point of injection; or the hydrocarbons diffused into the surrounding tissues; or there developed a severe tissue reaction described pathologically as "paraffinoma". There was also the danger of embolism, so that these substances have since been discarded.

In 1903, Foderl² employed celluloid, the popularity of which was short-lived. Still others have used gold and silver implants, with some degree of success. In 1918, Joseph² introduced ivory, and for a time this substance enjoyed wide popularity. It was readily available, easily sterilized and nonabsorbable, but, like all foreign substances used up to this time, it was not capable of becoming an integral part of the tissues and sooner or later either shifted or was extruded.

In 1879 Reverdin³ introduced the use of periosteum as a soft tissue transplant; in 1913 Rueda⁴ used bundles of catgut; while in

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1914 Koch⁵ used fascia. In 1933 Stout⁶ introduced bovine cartilage, but all of the above substances tend to undergo absorption. In order to overcome this objection, Magitot¹ advocated their fixation by formalin before introducing them into the body. This has not proven satisfactory and none of these substances is now being used.

Many have advocated the use of septal cartilage and bone to fill the saddle depression. The advantage of the method is its simplicity and ease of accomplishment; its greatest disadvantage is that so often insufficient material is available for adequately filling in the depression. Peer has published several papers to show that such septal cartilage grafts survive.^{7, 8}

Most plastic surgeons have settled upon autografts of costal cartilage as the safest and best type of implant. Some surgeons, notably the late Lee Cohen,⁹⁻¹⁷ have favored osteochondral grafts in which the outer table of rib bone was placed against the nasal bones and the rib cartilage was placed in the defect in the cartilaginous nasal dorsum. Until recently, this has been the method followed by the author.

In order to overcome the difficulties of obtaining autografts, numerous efforts have been made to employ isografts of costal cartilage; i.e., cartilage obtained from the same species (man) but not from one's own body. For this purpose fresh autopsy material has been obtained under sterile conditions, and then prepared and stored in various ways.

Human cartilage obtained in this way and preserved in alcohol was used rather extensively a generation ago to fill in depressions in the nose. However, the procedure was discarded because it was believed that such grafts were absorbed and replaced by fibrous tissue. O'Connor and Pierce¹⁸ revived the method, utilizing fresh cadaveric rib cartilage preserved in aqueous merthiolate solution and refrigerated until used. They kept the cartilage for as long as a year before use, without deleterious effect. The ultimate fate of these grafts is not fully known, but Peer⁷ reported that dead cartilage grafts buried from 9½ months to 2 years showed progressive invasion by fibrous tissue and partial absorption, whereas autogenous rib cartilage grafts showed no invasion or absorption over the same period of time. More recently, Peer⁸ stated that "this preserved type of cadaveric cartilage has a wide field of use and represents a valuable contribution to plastic surgery".

Recently a case report appeared in which a satisfactory immediate result was obtained with an isograft of costal cartilage which had been boiled soon after obtaining it, preserving it in alcohol until needed and then boiling it again before implantation.¹⁹

Since 1939 ticonium, plexiglass, vitalium and many acrylic resins have been suggested, but none of these has gained wide acceptance. In 1945 Fomon et al²⁰ advocated the use of cancellous bone obtained from the ilium as a graft in saddle-nose deformities.

It is obvious from the above brief review, that no "ideal" tissue implant substance has yet been found. The qualifications of such an "ideal transplant" require that it be readily available in sufficient quantity, that it be of a consistency that will permit easy modeling, that it be capable of resisting infection and absorption, that it be well tolerated by the tissue, that it not be subject to change in shape after implantation, and that it become an integral part of the tissues where placed. Whereas good results can be obtained by the use of autografts of rib cartilage, or rib cartilage and bone, the many attempts to find a more readily available substance emphasize the fact that such autografts are not the "ideal" transplant. On the other hand, the alloplastic materials thus far introduced have proven to be incapable of becoming an integral part of the tissues, and sooner or later, after the slightest trauma, are extruded from the tissues.

One of the surgical advances resulting from World War II was the introduction of tantalum. Although first introduced as a plate for closing cranial defects, it soon came to be recognized as an excellent nonabsorbable suture material, and has enjoyed widespread use as a tissue implant. More than sixty papers have been published on this "perfect metal" in surgery.

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Anders Gustaf Ekeberg, a chemistry instructor at Upsala College, Stockholm, discovered tantalum in 1802. He found what appeared to be an unknown element in a piece of ore, and spent his life trying to isolate it from its compounds. The tantalization which he endured in these efforts led him to name the new element "Tantalum", after Tantalus, the ill-fated son of the Greek god, Zeus.

Although a small amount of tantalum was produced in Germany from 1903 until the beginning of World War I, the metal was not produced on a commercial scale until 1922, when an Amer-

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ican metallurgist, Balke, developed new methods of producing this metal. Tantalum and its sister metal, columbium, occur together. The ore cannot be refined by smelting, and hence special methods of preparation are necessary. It has an extremely high melting point (2996° C.), a characteristic bluish-gray color, and a luster similar to platinum. It has a density of 16.6, about twice that of steel. The strength of unannealed tantalum is comparable to cold rolled steel. It compares favorably with stainless steel in its drawing, stamping and forming characteristics. It becomes work-hardened, or fatigued, at a much slower rate than most metals, a fact of considerable importance to surgeons. Tantalum may be machined with ordinary steel tools; and a reduction in thickness of 60% or more without intermediate anneal is common practice when it is being worked.

Chemically, tantalum compares with glass in its resistance to body chemistry. It is fully resistant to hydrochloric, nitric, hydriodic, and hydrobromic acids, and their salts, in any concentration, at any temperature at atmospheric pressure. It is also resistant to concentrated sulfuric acid at temperatures not greater than 79° F. It is fully resistant to dilute sulfuric acid at any temperature at atmospheric pressure. Hydrofluoric acid, concentrated sulfuric acid and strong alkalies in concentrated solutions attack tantalum. Weak alkalies cause no reaction, but salts of strong alkalies attack the metal.

CLINICAL INVESTIGATIONS OF TANTALUM

Burke²² was the first to report on a comparative study of the corrosion of metals in tissues in which tantalum was included in the series. Meanwhile Carney and Burch²³ were experimenting with tantalum in surgery, and their report appeared soon thereafter. These investigators felt that tantalum represented a truly biologically inert metal.

Numerous reports followed in which tantalum was employed as a plate in the fixation of fractures.²⁴⁻³⁰ There soon followed a large number of published reports on the use of tantalum plates in the closure of large skull defects, both surgical and traumatic.³¹⁻⁵² Pudenz and Odom⁵³ carried out experimental studies with tantalum foil in an effort to develop a material which would prevent meningo-cerebral adhesions, and reported the absence of foreign body reaction and failure of adhesion between the cerebral and meningeal

surfaces following prolonged application of tantalum foil to the surface of the brain. Others corroborated this work clinically.^{54, 55}

Further animal studies by Pudenz^{45, 46} in which tantalum plates were used to repair cranial defects demonstrate that tantalum provokes a minimal and nonprogressive encapsulation of connective tissue. Studies of bone bordering the tantalum plate show that osteoblastic activity is not hindered. This was corroborated by others.^{57, 58, 75} Animals surviving 318 days showed a complete closure of the cranial defect by formation of new bone tissue. The osseous layer adhered so closely to the tantalum plates that a bony impression remained even when the plates were removed.

Burke²² was the first to report the use of tantalum as a suture. Neurosurgeons soon took advantage of this material in repairing peripheral nerves, and reports by Spurling,^{59, 60, 61} Olson,⁶⁴ Schnitker,⁶² Scarff,⁶³ and others⁶⁵⁻⁶⁹ began to appear which established the fact that hair-like filaments of tantalum (.003 inch) can be used as through-and-through sutures or for end-to-end anastomosis with minimal foreign body reaction and little interference with the down-growing axones. Spurling⁵⁹ also reports the use of a tantalum foil cuff to protect the anastomotic site of nerve repair and to prevent adhesion to adjacent tissue. This method has been adopted for tendon repair by other surgeons.

It is a particularly valuable asset of tantalum that it can be used in infected fields. In contrast to silk, tantalum is impermeable and cannot harbor infection within its substance, thus reducing the chances for the development of a persistent draining sinus.

Olson⁶⁴ reports using tantalum wire sutures on a large number of hand injuries, using the wire for both buried and cutaneous suturing, without a single infection, even though most of the wounds were potentially contaminated. Kazanjian,⁴² Schnitker,⁴⁸ and others⁷² have reported the use of tantalum for repair of cranial defects after operation for osteomyelitis of the skull, without immediate or late complications because of the presence of the tantalum.

Several reports have appeared favoring the use of tantalum wire in the correction of facial paralysis.^{70, 71} Goodale⁷³ published an instructive paper on radical frontal sinus surgery in which he advocates the use of a strip of tantalum foil to prevent closure of the newly created nasofrontal duct. The author has tried this in one case with gratifying results.

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Newman⁷⁴ was the first to publish his results of the use of tantalum wool in correcting facial and cranial defects, although many others had been using the method for some time.

It may thus be seen that whereas tantalum found its earliest usefulness in the field of neurosurgery as a skull plate for closing cranial defects, either as an inlay or as an onlay, many other surgical uses have been found for this metal. It is now available in several different forms: sheet tantalum, tantalum sutures, tantalum wire, tantalum ribbon, tantalum hemostatic clips, tantalum foil, tantalum screws, and more recently tantalum gauze was introduced for the repair of hernial defects, etc. A wool fabricated from 0.003 inch tantalum wire is the substance used in rebuilding facial and nasal contours and to repair minor defects.

ADVANTAGES OF TANTALUM AS AN IMPLANT

Tantalum is readily available in any quantity at nominal cost. The wool is easily made from the .003 inch tantalum wire, and requires but a few minutes of the surgeon's time. There is no long preparation needed: the wire is simply sterilized on the spool, and is then prepared as a wool implant at the operating table. It is readily modeled into the appropriate shape and size, and ordinary surgical instruments (scissors, hemostats, forceps, etc.) are all that are required to prepare the implant. Once implanted, tantalum is resistant to infection and does not undergo absorption. It is well tolerated by the tissues, and soon becomes an integral part of them, so that it cannot be removed at a later date without the removal of some actual tissue. Fibroblasts grow into the interstices of the wool mesh and the tantalum implant soon becomes a fixed and immovable part of the tissues at the site of its implantation. When so implanted it is not rigid, like ivory, but has a firm elasticity much like the nasal tissues themselves. It will not change its shape unless severe trauma occurs to the parts, in which case the very nasal bones would probably suffer a similar fate. Tantalum permits tissue cells to attain their normal growth unhampered, and some investigators have reported that the attachment of fibroblasts to the metal itself can be demonstrated. Normal growth of bone over tantalum fixation plates and skull plates has also been repeatedly reported.

REPORT OF CASES

CASE 1.—A. R. P., aged 21 years, female, consulted me on September 13, 1944, because of a saddle-nose which resulted from

a septal abscess in childhood. The deformity was quite marked and there was an accompanying web-like adhesion of the left pyriform opening which occluded this side of the nose about 50%. The serological tests for syphilis were negative. On September 27, 1944, a rhinoplasty was performed under general anesthesia, in which an entire thickness of costal cartilage and the outer table of the seventh rib were implanted into the concavity under the skin of the dorsum of the nose. A splint was worn by the patient for ten days. The immediate result was excellent and the patient returned home (West Virginia). Correspondence ensued during the next several months and the patient continued to express delight with the result.

In January of 1946, about 15 months after the operation, the patient returned and complained that the nose was returning to its original state of saddle concavity. Examination revealed complete absorption of the cartilaginous implant with retention of the bone implant. On questioning the patient, she stated she first noticed a change "just before Thanksgiving" and it had progressively grown worse until the defect was quite obvious "by Christmas". Medical examination and blood studies failed to reveal any disease. The patient refused to undergo another rib resection. Since an autograft had failed, an isograft was not considered. The author had had some experience with tantalum as a skull plate, and it was decided to try a tantalum wool implant. Accordingly, on February 20, 1946, under local anesthesia, a tantalum wool implant was fabricated on the table and inserted beneath the skin of the dorsum through the usual intranasal lateral incisions. The incisions were closed with one black silk suture on either side, a splint was applied, and the patient was allowed to leave the hospital the next day. The splint was removed in five days. The patient was last seen on July 17, 1948, and the result was excellent. Recent correspondence from the patient indicates complete satisfaction with the result.

CASE 2.—H. S., aged 29 years, male, consulted me on April 29, 1946, regarding a rhinoplasty. He stated that in 1942 he had had a submucous resection in North Carolina and his "bridge dropped" afterwards. Examination revealed a well-marked concave deformity of the dorsum of the nose, and some scoliosis vertically because of lateral displacement of the left nasal bone with medial displacement of the right one. The septum was flail but essentially straight. The patient could only spend a few days in Baltimore and refused to have rib resection, so that it was decided to use a tantalum wool implant. The patient was told that no osteotomy would be performed at this operation but that this might be needed later.

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On April 30, 1946, under local anesthesia, a tantalum wool implant was inserted under the skin of the dorsum of the nose to fill in the concavity. The incisions were closed with one black silk suture on either side and a splint was applied for four days. The patient was discharged from the hospital on the second postoperative day. The immediate result was good. The patient has subsequently returned to Baltimore for examination in July of 1946 and in February of 1947, at which times the result remained good. Recent correspondence from the patient indicates complete satisfaction.

CASE 3.—J. W., aged 42 years, male, was first seen by me in January of 1945 while he was a patient at the South Baltimore General Hospital under another surgeon's care. He was a railroad worker who had been in a serious railway accident in May of 1943 and had suffered numerous injuries, among them a compound, comminuted fracture of the nose, loss of the upper half of the right auricle, a depressed fracture of the right maxilla and zygoma, and loss of considerable skin of the forehead by avulsion. I was asked to see the patient because of a fistula which was present on the dorsum of the nose as a result of the compound fracture. Two previous attempts at surgical closure had failed, the last of which included a pedicle graft to the nose from behind the ear.

The fistula was through-and-through but not in a straight line, and was situated just to the right of the midline, near the lower border of the right nasal bone, which was deficient. There was a skin defect about 2 mm. by 5 mm., running diagonally, with the long axis in the vertical direction towards the tip. Repeated chemical cauterizations, externally and within, temporarily closed the perforation, but it always reopened soon afterwards. Meanwhile the skin edges began to show evidence of retraction, so that the defect grew larger.

On May 27, 1946, while implanting tantalum wool into the zygomaticomaxillary defect of the face, the edges of the skin of the nasal fistula were freshened and slightly undermined, a small piece of tantalum foil was inserted, and the wound edges were approximated with atraumatic silk sutures. For a while it was thought that healing would take place. Soon, however, the skin edges separated and began to retract and a status quo resulted, i.e., the fistula was closed for all intents and purposes (by tantalum foil and granulations) but the skin would not heal over the defect. It was decided to do a more extensive plastic resection and closure.

Accordingly, on June 2, 1947, under local anesthesia, the skin over the entire dorsum of the nose was elevated through the usual

intranasal lateral incisions. The tantalum foil had become so imbedded in the tissues, and so engulfed by them, that it could not be removed if desired. The skin edges of the fistula were again freshened and brought together with vertical mattress atraumatic sutures of No. 00000 silk placed every 2 mm. apart. Thrombin solution was spread beneath the skin of the dorsum and the overlying skin fixed in place where desired. A splint was applied and worn for several days. The sutures were removed, half in three days and the rest on the seventh day. The fistula healed promptly and has remained closed to date.

This case illustrates the tolerance that the tissues have for tantalum even in the face of infection and an open wound.

CASE 4.—R. P., aged 23 years, male, consulted me on November 17, 1945, because of marked nasal obstruction and nasal deformity. He stated that he had broken his nose in childhood and that no immediate correction was effected. However, two attempts at submucous resection had been made in the past few years, the last one while he was in the Army in December of 1943, but without relief of obstruction. Examination revealed a markedly scoliotic nose, with the tip deflected to the right, and a very large bony hump on the dorsum. The columella was sunken and the columellar support was absent, but the remaining septal cartilage appeared to be present although markedly deflected and scoliotic, so that both sides of the nose were obstructed. The condition was explained to the patient, and he was advised to have a submucous resection and rhinoplasty, preferably at the same operation.

On November 28, 1945, under local anesthesia, a modified submucous resection and rhinoplasty were performed, in which it was necessary to remove practically the entire septal cartilage as well as perform a bilateral osteotomy and remove the hump. A portion of septal cartilage was reinserted for support, but considerable concern was felt at the time lest a saddle defect develop. The postoperative course was complicated by an injury to the nose sustained in an automobile accident while the patient was still wearing the splint. This necessitated some manipulation of the nasal bones and reapplication of the splint at a time when there was very marked edema and ecchymosis present. The patient was discharged in January of 1946 with only a slight lateral displacement of the right nasal bone which was attributed to the injury sustained during the early postoperative period. There was an excellent breathing space on both sides and the patient was quite happy with the result.

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In August of 1946 the patient returned for examination because a definite saddle deformity had become apparent where the cartilaginous septum was resected. Examination revealed that the reimplanted septal cartilage had become absorbed. A secondary rhinoplasty was advised for implantation of tantalum. On September 26, 1946, under local anesthesia, a tantalum wool implant was inserted under the skin of the dorsum of the nose to fill in the concavity. A splint was worn for several days only. The patient has been seen fairly frequently since operation, and he has an excellent result.

CASE 5.—R. C., aged 33, male, was referred to me by another otolaryngologist on October 7, 1946, because of a saddle deformity of the nose which resulted from an injury sustained on September 11, 1946, in an automobile accident. Examination revealed a large septal perforation from previous submucous resection, separation of both nasal bones at the dorsum, with a depression at the osseocartilaginous junction. There was a small scar over the right nasal bone. A tantalum implant was advised.

On October 9, 1946, under local anesthesia, a tantalum wool implant was inserted under the skin of the dorsum of the nose to fill in the concavity. A splint was applied and worn for several days. The patient left the hospital on the second postoperative day. The result was excellent, and the patient has been seen frequently since operation.

CASE 6.—C. C., aged 23 years, female, consulted me because of dissatisfaction with the result obtained after three consecutive rhinoplastic operations by another surgeon. At the time of her first visit on February 14, 1947, examination revealed the tip to be quite bulbous and deflected to the right of the midline. There was a red blush horizontally across the skin of the dorsum of the nose at the osseocartilaginous junction because of pressure from underlying cartilage and there was a well-marked saddle deformity. The right ala was somewhat lower than the left one, but a similar asymmetry existed throughout the face. Within, there was fairly marked occlusion of both pyriform openings due to cicatricial contracture and adhesion of the alae to the septum at the dorsum. Secondary rhinoplasty was advised, and this was accepted.

On March 5, 1947, under local anesthesia, a secondary plastic operation was performed in which a tantalum wool implant was inserted under the skin of the dorsum to fill in the concave deformity,

the cicatrix within each naris was excised, and the tip was made less bulbous. A splint was applied for four days. The patient left the hospital on the second postoperative day. The immediate result was excellent, and the only change that has occurred with time is that the thin skin of the dorsum again shows its reddish blush where it is stretched over the implant.

In October, 1947, the patient returned because of numerous small pustules over the thin skin of the dorsum just at the site of the tantalum implant. Soon thereafter several small filaments of tantalum wire appeared through the skin of the dorsum. These were snipped short with a small scissors, but more appeared during the next several months. Also, pustules recurred periodically. The patient was advised to have a secondary operation, and on April 6, 1948, under pentothal anesthesia, the skin of the dorsum was elevated through bilateral intranasal incisions. The tantalum wire implant was found tightly adherent, but was separated by careful dissection. Several small puncture points were noted in the skin after it was elevated. A strip of fascia lata was taken from the right thigh and this was inserted beneath the skin of the dorsum of the nose between the skin and the tantalum implant. A splint was re-applied and worn for five days. The nose healed promptly, the bluish discoloration previously noted on the dorsum (tantalum beneath the thin, split skin) was no longer present, and the skin perforations promptly healed. There has been no further difficulty and the patient is quite satisfied with the result.

CASE 7.—V. E. S., aged 34 years, male, consulted me because of marked nasal obstruction. He gave a history of having had a submucous resection performed by another surgeon in 1933, after which he stated his tip fell. Examination revealed a vertical deformity, with a depressed dorsum, an overhanging tip and sunken columella. There was no columellar cartilaginous support, the tip was deflected somewhat to the right, and both nares were almost completely obstructed. This latter state could be relieved by manual elevation of the tip. The septum was somewhat thickened anteriorly, and was almost totally lacking in cartilaginous or bony support. Both lower turbinates were very prominent and failed to shrink normally upon the application of a vasoconstrictor.

Rhinoplasty was advised, and on March 18, 1947, the operation was performed under local anesthesia. The tip was elevated a full 1 cm., thus shortening the nose, and a tantalum wool implant was inserted beneath the skin of the dorsum of the nose to fill in the

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concavity and support the tip. At the same time both lower turbinates were infracted laterally and compressed. A splint was worn for four days, and the patient left the hospital on the second post-operative day. The result has been excellent, both cosmetically and as to function.

SUMMARY

The history of tissue transplants and implants is briefly reviewed, and the advantages and disadvantages of the various materials are discussed. The requirements for an "ideal" implant are also stated, and it is concluded that no such ideal substance has yet been found.

A brief review of the history, and of the physical and chemical properties of tantalum is presented. Its introduction into surgery is discussed, and an extensive bibliography is presented of the literature published on the subject. Seven case reports are presented in which tantalum implants have been employed successfully by the author in rhinoplastic surgery.

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V

VERTEBRATED MAGNETS FOR REMOVAL
OF FOREIGN BODIES FROM THE AIR
AND FOOD PASSAGES

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AND

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As stated by Equen,¹ "Doctors have been working with magnets for many years. It is just since a powerful magnet which could be made small enough to be introduced through a bronchoscope that it has proved most effective." Forty-three years ago a long series of researches and experiments were reported,⁷ formulating the principles underlying the use of magnetism for the removal of ferrous foreign bodies from the air and food passages and giving a list of instrumental means that had been worked out in the practical application of the principles involved. Later researches⁶ carried the experiments further, and a powerful electric magnet was used to draw downward and fix for grasping with forceps a steel-jacketed machine-gun bullet that was located "around the corner" in the left upper lobe. The models of instruments developed in researches included rod magnets; rods for permanent magnetic activation; rods for interrupted electromagnetic activation; vertebrated rods for magnetic activation; chains for magnetic activation; magnetic forceps; forceps for interrupted electromagnetic activation; projected core magnets; solenoid magnets; powerful magnets for activation of rods, chains, etc., and for magnetic fixation. Practical results were obtained only in cases in which the foreign body could have been more easily removed with forceps, because of the feeble magnetic energy exerted by the best means known to the physicists of that time. The best rod magnets were the permanently magnetised rods of quench-hardened tool steel.

In recent years, a great industrial demand arose for a permanent magnet of greater magnetic energy than that exerted by the permanent rod magnets of quench-hardened 1% carbon steel. The

demand led to the development of the alnico magnet by the General Electric Company. It is made of an alloy chiefly of aluminum, nickel, cobalt and iron and has great permeability as well as indefinitely long retention. The alnico magnets are now made in an endless variety of shapes and sizes for manifold industrial purposes. There are about 300 built into an airplane. Various formulas and processes for making the alloy have been developed for various special industrial requirements.

Instruments using the alnico magnet have been devised and successfully used for removal of foreign bodies from the air and food passages by Equen,¹⁻⁴ Silber, Kaplan and Epstein;¹¹ Holinger;⁵ Tucker,¹² Penta¹⁰ and others. Silber, Kaplan and Epstein removed a ferrous padlock from the stomach. Equen used a Levin duodenal tube as a carrier for the alnico magnet for removing a number of ferrous foreign bodies (bobby pins) from the stomach. For the removal of ferrous foreign bodies from the duodenum in 3 cases^{1,2} he had the child swallow an alnico magnet attached to a string with which the foreign body was removed after the magnet had passed into the duodenum and made contact. For use in the tracheo-bronchial tree he used successfully a ureteral catheter as an alnico magnet carrier. Holinger⁵ advocated rigid stems of brass for better control and for safe disengagement of the foreign body from the magnet by pushing downward with the endoscopic tube. At our clinic the alnico magnet has been used in 15 cases for removal of ferrous foreign body: a nail from the right lower lobe bronchus; 10 bobby pins from the stomach, and a bobby pin from the duodenum; a washer, a screw and a hairpin from the stomach.

Of the various forms of magnets described in the researches and experiments mentioned in the first paragraph above, the vertebrated rods are well adapted to alnico construction. With a view of increasing facility of magnetic removal of ferrous foreign bodies from the esophagus, stomach and the less accessible parts of the tracheobronchial tree, we have worked out four forms of vertebrated magnets to add to the magnetic armanentarium (Fig. 1). The magnets are carried at the distal extremity of the vertebrated end. The four forms enable the operator to reach and enter practically all segmental bronchi and to pass the magnetic end in any peripheral direction as far as it is possible to work without risk of traumatizing the parietal pleura. The vertebrated distal ends of the four instruments are as follows:

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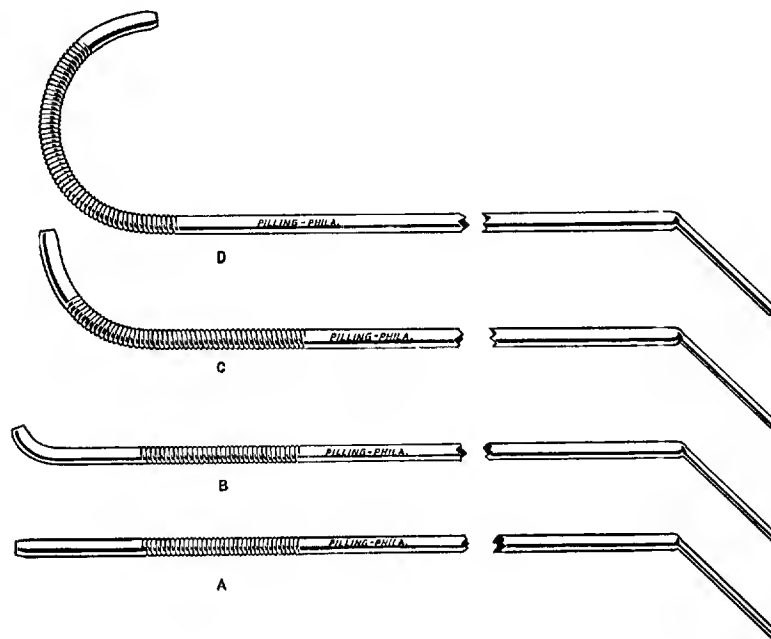


Fig. 1.—Vertebrated magnets for removal of foreign bodies from the air and food passages.

A, is a straight form; the flexibility of the vertebrated portion permits accommodation to tangential deviations up to about 4° or 5° , as it yields in following lumina in approximately caudad directions. By manual rotation of the angular handle the magnetic distal end can be guided into segmental bronchi of small tangential angles in any caudad direction by biplane fluoroscopic guidance, in cooperation with the radiologist. Both major segmental orifices of the middle lobe can be similarly entered with this magnet or with the one described in the paragraph below (B).

B. The extreme distal end of this magnet is bent at about a 60° angle; the spring of the vertebrated end of the curve enables the magnetic end to deflect in passage down either main bronchus and automatically enter any orifice to which it may be pointed under control of the handle: for example, the orifice of either upper-lobe bronchus.

C. On this model the entire vertebrated part is curved 90° on a 2-cm. radius and in model D, the entire vertebrated end is curved 180° , on a 25-mm. radius. On the same mechanical principle as the

upper-lobe bronchus forceps, the vertebrated distal end of both the 90° and the 180° forms straightens out for passage through the bronchoscope, esophagoscope or open-tube gastroscope, resuming its curve after emerging at the distal tube mouth, the radius of curvature being controlled by the degree of emergence permitted by the controlling fingers on the angulated handle.

The inferior segmental branch of the lingular division of the left upper-lobe bronchus is easily found with the guidance of the eye at the bronchoscope; then the straight vertebrated magnet can be inserted into the orifice, and deeper passage will be controlled under guidance of the biplane fluoroscope, in co-operation with the radiologist. The superior segmental branch will require the 90° curved vertebrated magnet, or in some cases, the 180°. The anterior and apical posterior branches will require the 180° curved instrument.

The vestibule of the right upper-lobe bronchus is easily entered with the short angular tipped model, B, by simply keeping the conical distal end pointed toward the right in the coronal plane as the magnet is passed down the right bronchus, or toward the left in the case of the left upper-lobe. Though a click may be felt as the ferrous foreign body jumps into contact, the whole procedure should be done under fluoroscopic guidance. The anterior and the posterior segmental bronchi of the right upper lobe are reachable with the 90° curved vertebrated magnet. The apical segmental bronchus will require the 180° curved vertebrated form. In both these procedures utmost caution and slowness in permitting emergence are necessary to avoid pushing the foreign body toward the periphery, where difficulties would be greater.

Endogastric version of steel safety-pins and endogastric cephalic version of staples may be done with the vertebrated magnets A and B, under fluoroscopic guidance, using the vertebrated magnet in the same way as the ring-rotation forceps are used in the Chevalier Jackson technic of endogastric version. The magnetic energy is not sufficient to pull the safety-pin into the tube mouth and close it, as can be done with the forceps, but the pull is sufficient to draw the safety-pin up through the esophagus trailing, if kept near, but not touching, the tube mouth.

The magnetic energy of the alnico magnet leaves only one absolute limitation, namely, the foreign body must be permeable to magnetic energy. This eliminates all except ferrous foreign bodies and foreign bodies of a few rarely encountered metals. However,

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iron and especially steel are commonest of metallic substances and now that they are available in practically inoxidizable alloys, they are increasingly supplanting brass and other alloys of copper for manufacture of many small objects. To determine magnetic permeability of a foreign body in a particular case Equen has used the Berman locator developed by the Waugh Laboratories. When passed on the external surface of the patient's body it will buzz as the region of a ferrous foreign body is approached. If this instrument should be unavailable, a heavy electric eye magnet may be used. Close watch at the fluoroscopic screen with visual axis 90° to the plane of the magnetic lines of force will detect slight movement of the foreign body toward the magnet as the core is quickly approached to the chest wall, if the foreign body is ferrous and of sufficient size.⁹

Magnetic energy of any degree is absolutely harmless to human tissues. Apart from trauma, which is entirely avoidable by gentleness and care, only one precaution is particularly necessary. A magnet made from cast alnico alloy is extremely brittle; it must be handled with utmost care and gentleness. The sintered alnico alloy is less brittle but is brittle enough to require utmost care in handling to prevent breakage which would add another feature to the foreign-body problem, namely, the physical law that when a magnet breaks, each fragment is polarized, and the other physical law that like poles repel. Therefore if fracture of an alnico magnet should occur the fragment should be removed with a soft iron rod of the same form as the magnet carrier used in the case but unmagnetized to avoid possible repulsion by like poles. Soft iron would not polarize and the fragments of the broken magnet would attach themselves to it. Unmagnetized forceps might be used, if better suited to the particular case, but they might become polarized by the broken magnet if the grasp were released, unless they were entirely of brass.

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VI

ANESTHESIA IN FENESTRATION SURGERY

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There has been, from the very first, serious controversy regarding the ideal anesthesia for fenestration procedures. The early workers in the field have steadfastly adhered to a regime of heavy preoperative medication plus a "hands off" policy during the actual operation. This attitude may have been considered legitimate in 1938: otolaryngological anesthesia, according to modern concepts, had little to offer then.

The comparative lack of safety, the prolonged and even severe periods of suboxygenation, the unmanageable restlessness of some patients on the operating table, and the dull prospects of serious postoperative states of hypotension and respiratory insufficiency have caused a great many clinicians to abandon this method of anesthetic management. Unfortunately, the alternatives, chosen at random, have been in many instances no better. Thus, the heavy usage of depressant drugs preoperatively has continued.

The surgical requirements for this, the most intricate and delicate form of surgery yet devised, are simple and few, but exacting. The surgeon will demand a quiet, and at times, completely immobile patient. Unquestionably he prefers a bloodless field during the latter third of the procedure, for indeed his ratio of success is in direct proportion to the dryness of his operative field. Lastly, he would be pleased and reassured if the vital statistics, during the operative as well as the postoperative periods, are well within normal physiological limits.

Let us consider first the several objections voiced by the otologists to some of the methods now in common usage among anesthetists. Management under diethyl ether is very frequently advocated but we are told that the induction takes considerable time, and that endotracheal intubation is not without its well known hazards of trauma to the cords and adjacent structures. We may, parenthet-

ically, answer this objection by stating that the danger of cord damage is almost negligible when compared to the advantages of a clear airway. Recovery and postoperative management may be long and detailed, especially since the surgery itself causes vertigo and nausea to a great extent. Diathermy cannot be used with absolute safety; the patient cannot be "word-tested" on the table. It is believed that bleeding is more likely and more serious with ether than with other anesthetics. Finally, the well known objections of many patients to the ordeal of ether induction must be taken into account.

Those who rebel against the use of deep basal anesthesia with preoperative barbiturates and opiates do so because of the great and unpredictable variability of result in that some patients are lightly, and some too deeply anesthetized. Patients become quite restless at times and often delirious on the table. This frequently causes postponement of the surgical procedure. Postoperative morbidity rates are understandably high, and occasionally a death is reported. Nausea and emesis are serious and may occur at crucial times during the operation. The amounts of supplemental anesthesia necessary may cause further respiratory depression which cannot always be satisfactorily handled in some clinics. Finally, the straining observed under some conditions of pain and struggling causes troublesome bleeding.

Lately tribromethanol (Avertin) anesthesia has been advocated by some not only for its anesthetic effect but for its tendency to cause hypotension which would help to maintain a bloodless field. The dangers inherent in such a regime are fairly obvious when we recognize the serious and even irreversible pathological changes that sustained hypotensive states will engender in the kidneys, myocardium and brain. Except under unusual circumstances the use of Avertin has been ruled out quite universally, and justly so. Toxic liver manifestations, in spite of preoperative diets rich in sugars, severe hypotensive states and episodes of respiratory depression, as well as the serious lack of control on the part of the anesthetist have rightly combined to oust this agent from our consideration.

In an endeavor to assess the value of and compare adequately some of the common methods of management, and to accumulate a list of operative and postoperative complications, we have outlined a method of study we have pursued during the past two years.

One hundred consecutive operations on 92 patients extending to June 30, 1948, have been studied. This series includes 62 women

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and 30 men whose total average age was 34.2 years. Our youngest patient was 17, and our oldest 59.

No serious physical or psychological contraindication either to surgery or to anesthesia was encountered. All these patients had otosclerosis and were referred to and examined by physicians of the Winthrop Foundation, interviewed by the Social Service Department member attached to the Clinic and later discussed openly by a panel of physicians as to the advisability of operation.

The following minor conditions revealed themselves after careful physical and psychological examination:

1. Mild hypotension, 10 cases (average blood pressure 102/74).
2. Secondary anemia, 11 cases (average hemoglobin of 11 gm.).
3. Undiagnosed cause of albuminuria, 3 cases.
4. Hypo-ovarianism, 2 cases.
5. Tuberculosis, arrested, 2 cases.
6. Mild bronchiectasis, 2 cases.
7. Allergic rhinitis, 2 cases.
8. Psychotic backgrounds, 4 cases.

None of these conditions could be related to any of the operative disturbances encountered, and no distinction was made in this series of 100 as far as choice of anesthesia, surgeon, or anesthetist was concerned.

Regarding distribution of cases among the surgical personnel, the Chief of the Clinic operated on half (54%) of this series, and the remaining half was divided between four associates. With the exception of the operations performed under pentothal sodium or pentobarbital sodium (Nembutal) which were conducted by a physician anesthetist, more than half of these cases were managed by competent nurse technicians under the supervision of a physician anesthetist.

PREMEDICATION PLANS

The cases in this series were divided as follows: 57 patients were medicated rather heavily and then operated on under procaine hydrochloride (Novocaine) regional block alone; 43 patients were lightly medicated in comparison and were conducted under gas-oxygen-ether sequence, or under pentothal or Nembutal administered intravenously together with procaine infiltration. The following table demonstrates the differences in premedication between the two groups which will hereinafter be designated as plan "A" or plan "B".

TABLE 1.
PREOPERATIVE PREMEDICATION AND ANESTHESIA PLANS

Plan "A" (Followed by Regional Anesthesia)				Plan "B" (Followed by Nemb., Pent., GOE)		
Nembutal	p.o.	0.2 gm.	7:00 a.m.			
Neonal	p.o.	0.2 gm.				
			7:30 a.m.	Seconal	p.o.	0.1 gm.
Demerol	s.c.	100 mg.	7:45 a.m.			
			8:00 a.m.	Demerol	s.c.	100 mg.
				Atropine	s.c.	0.6 mg.
Nembutal suppos.		0.2 gm.	8:15 a.m.			
To operating room			8:45 a.m.	To operating room		

TYPE OF ANESTHESIA USED

Drugs	Number of Cases	Premedication Plan
Procaine block alone	29	"A"
Procaine with Demerol or other supplemental agent	28	"A"
Procaine with Nembutal IV	15	"B"
Procaine with pentothal IV	15	"B"
Gas-Oxygen-Ether	13	"B"

It will be observed that of the 57 cases originally scheduled under procaine block alone, almost half (28) required some form of supplemental anesthesia during the course of the operation. This at times becomes necessary with the medication under plan "A"; in clinics where supplemental drugs are not allowed the amount of premedication used is almost triple the doses we have employed under plan "A". Methemidine hydrochloride (Demerol), in doses of 25 to 50 mg. intravenously, was routinely first used in all cases requiring supplement. If an initial dose proved insufficient to control pain, nausea, or restlessness, a second dose was given after an appropriate interval. No case of this type was given over 100 mg. of Demerol during the course of the entire procedure. Of these 28 cases, four

required nitrous oxide-oxygen mixtures by the semiclosed technique within an average time of 50 minutes from the start of the procaine block. Lastly, in three of these four cases, it was found either necessary or expedient to add ether to the gas mixture, and thus deepen the anesthesia to the required plane.

Procaine hydrochloride 2%, with epinephrine 1:50,000 concentration, was used routinely for the block. If large quantities of procaine were to be used, the concentration of epinephrine was limited to a 1:200,000 strength. The efficacy of the block varies greatly in the hands of different operators, and is directly concerned with the amount of supplement anesthesia required during the course of the operation. This was shown by the fact that all of the patients operated upon by either one of two associates required sizable doses of supplemental drugs. In only one-fifth (19%) of the remaining patients, blocked and operated on by one of the three other surgeons, was supplemental anesthesia found necessary.

Definite indications for the use of supplemental medication such as Demerol, are found in the following occurrences:

1. Minor movements of hands or feet.
2. Steady increase in respiratory rate and tidal volume.
3. Sharp increase in pulse rate.
4. Restlessness and head movements while unconscious.
5. Verbal complaints of pain or tiredness.

The first few cases done under pentobarbital sodium (Nembutal) were handled by the "Drip" method, but the great majority were induced simply with an initial intravenous dose of approximately 3.5 cc. (0.25 gm.) within the first five minutes. Varying amounts were thereafter given as necessary. We have routinely used "Solution of Pentobarbital Sodium" (Abbott), each cubic centimeter representing one grain or 60 mg. of the drug.

Pentothal sodium, when used, was administered in a solution of 2 ampoules (2 gm.) to 500 cc. of 0.85% saline, thus representing a 0.4% concentration of the drug. This infusion was controlled by a tunnel clamp to ascertain the amounts given per minute. It was found necessary in most of the cases to maintain anesthesia at

Table 4 illustrates the complications encountered as well as their incidence. Several interesting points may be demonstrated in a comparison such as this. It is understandable that one-fourth of plan "A" patients should be in a rather deep stage of narcosis on arrival at the operating room. It has been our observation that in clinics using even heavier premedication routines than ours more than two-thirds of the patients seen immediately before operation are in dangerously deep levels of barbiturate intoxication.

Respiratory depression was encountered in one-third of the first group and only half as frequently in the second group and then later during the procedure. Depression was considered to be present

about the level of early third stage for most of the procedure. At certain points along the way, that is, the initial incision, preparation of the skin flap, making of the new window, and packing with hot paraffin wax, the anesthesia could and was lowered appreciably. It was very gratifying to observe the ease with which the different planes of anesthesia could be controlled by the anesthetist using this dilute solution of pentothal. Pentothal was never allowed to become the analgesic factor in the procedure, for additional procaine injections, instillations of a few drops of 10% cocaine in the middle

if respirations remained at a level of 10 or lower per minute for 10 minutes, or 12 or lower for 20 minutes minimally. It was further noticed clinically, and with some consistency, that tidal volumes were appreciably lower among patients in plan "A". Administration of oxygen was more frequently resorted to for these patients in an attempt to bolster blood oxygen concentrations when rising pulse rates or pale, perspiring appearances of the skin indicated some degree of respiratory insufficiency and suboxygenation. This greater depression was carried on, as will be shown, into the recovery period also. As was expected, the tidal volumes of the patients done under Nembutal were greatly decreased, and constitute 5 of the 6 cases seen in this group under plan "B".

The apparent prophylactic value of Demerol, and/or atropine sulfate preoperatively, is demonstrated in the fact that 6 of a total of 8 cases under plan "A" with annoying and rather constant nausea had not received this drug either as premedication or as supplemental anesthesia during the operation. Of much interest also was the fact that bleeding was "moderate to troublesome" (to quote from the surgeon's operative notes) in 14% of the first group, and only one-third as pronounced in the second group where, it should be noted, 13 cases of the 43 were conducted under the much maligned diethyl ether. It was not possible, in our experience, to indict ether in this regard where the anesthesia was conducted smoothly and carefully, and when an endotracheal technique was employed.

Pain, restlessness, and poor relaxation were slightly higher in the second group, but the patients responded much better to supplemental anesthesia than did those in the first group. Of a total of 19 cases among both groups, eight were associated with varying degrees of anoxemia; these eight were patients treated under plan "A". This, apparently, is the price to be paid for a totally immobile patient during the entire operation.

Table 5, which depicts the postoperative complications, reveals a total of 34 complaints among 21 patients. None of these were at all serious except perhaps three of the six cases with "more than usual dizziness", and, of course, the two cases of facial palsy. These, fortunately, were of very short duration. It is noteworthy that with the possible exception of the "hypotensive" group, all recorded complications, though all mild in character, fell into the plan "A" group. We also see confirmed our belief that patients operated on under continuous Nembutal medication are very slow in recovering consciousness postoperatively.

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TABLE 5.
POSTOPERATIVE COMPLICATIONS.

Types	Totals	Plan "A"	Plan "B"	Anesthesia		
				Local	Pent.	Nemb.
Hypotensive states	16	9	7	9	2	5
More than usual vertigo	6	6	0	4	2	0
More than usual nausea	3	3	0	3	0	0
Severe dermatitis	1	0	1	0	1	0
Transient palsies	2	2	0	1	1	0
Tachycardia	2	2	0	2	0	0
Prolonged recovery	4	1	0	1	0	3

We have had no deaths from any cause among the patients of this series, the earliest of which were operated on over a year ago. Neither have we run across any pulmonary complication, that is: atelectasis, pneumonia, or tracheobronchitis, in either group. We have not seen postoperative manic demonstrations, severe gastrointestinal disturbances, or cardiovascular accidents. The great majority of these patients have been most happy and well clinically within 24 hours of their surgical experience.

We are planning a more complete method of clinical investigation for the immediate future. One fourth of the cases will continue to receive the routine under plan "A" merely as controls, and will be compared to a like number which is already being treated under a regime of greatly reduced preoperative medication associated with the more liberal use of nitrous-oxide-oxygen and intravenous medication (Demerol) during the operation. We believe this will afford more control over the patient than is possible with heavy premedication alone. The remaining half will be conducted as in the past with "Drip" pentothal and a minimum of premedication. We further intend systematically to calibrate tidal volumes and ascertain blood oxygen levels in all patients.

The surgeons and personnel of the Winthrop Foundation have contributed greatly to the accumulation of this data by their courteous understanding and unfailing co-operation. It is our earnest hope that other groups may be influenced to work on the specific problem of anesthesia in fenestration surgery and also report their trials and tribulations.

ANESTHESIA DEPARTMENT
MASSACHUSETTS EYE AND EAR INFIRMARY.

VII

CHONDROMA AND CHONDROSARCOMA
OF THE LARYNX

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The benign neoplasms of the laryngeal cartilages known as chondromas are especially rare tumors when compared with their incidence in other regions of the body. Of course, the literature of any subject represents only the cases reported. Nevertheless, the rarity of cartilaginous tumors of the larynx has been fully borne out by the clinical experiences of the older group of laryngologists.

The first comprehensive survey of the world's literature on laryngeal chondromas was made by Irwin Moore¹ in 1925. He collected 62 cases reported as chondromatous tumors of the larynx, but excluded nine of those because five were diagnosed on insufficient evidence and four were instances of hypertrophy. He therefore collected 53 cases which he considered to be true cartilaginous tumors. The most recent survey was made by McCall, Dupertius, and Gardiner² in 1944 who collected an additional 30 cases since Moore's report and added two of their own, making a total of 85 cases. Rosedale³ in 1947 and Moore⁴ in 1948 each reported a case and these, with the case presented here, brings the total to 88 cases reported in literature.

Site.—According to the reviews the favorite site of development of chondroma of the larynx was on the endolaryngeal surface of the posterior plate of the cricoid cartilage, followed by the thyroid cartilage, the epiglottis, and the arytenoid cartilage in order of frequency, with the greatest number arising from the cricoid cartilage. In the case of the true chondroma presented in this paper the origin was from the cricoid cartilage.

Pathology.—Ewing⁵ states that localized overgrowth of cartilage occurs in several forms between which it is sometimes difficult

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to draw sharp distinctions. Limited outgrowths of pre-existing cartilage occurs on the ribs, in the larynx, and about joints which exhibit the characteristics of a simple hyperplastic process, and are called *ecchondroses*. *Enchondromas* or *chondromas* are tumors that presumably start from cartilaginous cells in noncartilaginous tissue. This differentiation is of extreme value in a clinical way for the tumors that spring from cartilages of the larynx in most cases involve and obliterate the normal laryngeal framework so that the larynx is destroyed; whereas the tumors that start in the region of the larynx, entirely disconnected from any of the laryngeal cartilage, may compress the larynx almost to the point of obliteration, but when removed, the uninvolved laryngeal cartilages can resume their original positions and the larynx can resume its function.

In general the true chondroma is a rather common tumor. It is a benign tumor of mesodermal origin with the histologic characteristics of the various normal types of cartilage, chiefly the hyaline variety. Ranvier¹² classified chondromas according to their structure in four groups: (1) a single lobe of hyaline cartilage, (2) several lobules of hyaline cartilages separated by fibrocartilage, (3) fetal cartilage and (4) cartilage with stellate cells. Histologically there is no difference between chondroma of the larynx and those of other parts of the body. The cells are characterized by clear or vacuolated staining ovoid or stellate nuclei. The cells may be more or less numerous than in normal cartilage. They vary greatly in size and usually lack the orderly arrangement into groups of cells with opposed surfaces flattened. The growing cells of a chondroma are not, as a rule, those enclosed in the matrix, but rather those on the periphery of the tumor.

The chondroma usually produces a hard, rounded, lobulated tumor which may reach large dimensions. The nutrition of the solid chondroma is maintained by a rich system of lymphatics from the periphery. It is because of this characteristic of being maintained by lymph that one may find these tumors in locations such as joints and in spaces in which other connective tissue tumors could not ordinarily attain such dimensions.

While most chondromas are solid, many become softened by mucinous degeneration and cysts filled with mucinous, serous or fatty material may form. Chondromas are usually localized and benign; they sometimes grow extensively into blood vessels, filling

the lumen with nodular or solid masses and extending over wide areas. These latter cases should be considered malignant and classified as chondrosarcoma.

The understanding of chondrosarcoma is still being hindered by the idea that to make a diagnosis of chondrosarcoma on a histologic basis alone is often difficult, if not impossible. This difficulty exists for the better differentiated cases, while in the frank sarcomatous tumors a histological diagnosis of malignancy is usually obvious.

Lichtenstein and Jaffe⁷ believe that even in certain apparently benign cartilaginous tumors one will find, at least in scattered fields, if adequate material is examined, subtle but tell-tale evidences of cytologic atypism of the cartilage cells which will betray the malignant character of the lesion. They hold that a cartilage tumor should no longer be regarded as benign if, when viable and not heavily calcified areas are examined, it shows even in scattered fields (1) many cells with plump nuclei, (2) more than an occasional cell with two such nuclei, and especially (3) any giant cartilage cell with large single or multiple nuclei or with clumps of chromatin.

Even if left to themselves, some chondrosarcomas of well differentiated type are likely to remain only locally invasive for years, but when they finally spread the tumors tend to break into the regional venous channels, and, by intravascular growth and extension, may reach the heart and lungs. The possibility of lymphatic spread also exists and extension of the tumor to lymph nodes, especially regional, has occasionally been reported.

Symptoms.—Symptoms of chondroma of the larynx vary according to the situation and its size and rate of growth. As a rule, these growths develop slowly and their presence may be noted only when they begin to interfere with function.

Jackson and Jackson⁵ state that it is well to remember that in the early stages of chondroma of the larynx, especially of the cricoid cartilage, the only sign may be impaired motility. They observed three cases where chondromas developed in the larynx with slightly impaired adduction but no evidence of arthritis or of impairment of the crico-arytenoid joint.

When the tumor is within the larynx the symptoms depend upon the location. If located on the posterior surface of the cricoid

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cartilage, the symptoms will be for a long time those of difficulty in swallowing, rather than those of breathing. When the growth starts on the endolaryngeal surface of the posterior plate of the cricoid cartilage, as it does in most cases, the encroachment upon the breathing space will be more noticeable. Wheezing and dyspnea are early symptoms and asphyxia will result sooner or later if trachetomy or other surgical relief does not prevent it. Hoarseness is a prominent symptom when the tumor interferes with laryngeal motility. Impaired adduction may produce air waste; aphonia with whispered voice will be present in most of the cases in the later stages.

The breathing difficulty may be mild for a long period with sudden development of extreme dyspnea in case of any change that affects the larynx. This sudden development of extreme dyspnea may be caused by an episode of acute laryngitis with resultant laryngeal edema, or may be caused by obstruction of the laryngeal airway by food becoming lodged there while eating. Cough may be present and is frequently the most troublesome symptom.

Tumors arising outside of the larynx may cause no symptoms and the only complaint may be the swelling in the neck. The symptoms referable to the larynx or to the esophagus may be so mild as to be ignored by the patient until laryngeal or esophageal obstruction creates concern or alarm.

Diagnosis.—If the neoplasm protrudes into the interior of the larynx, the diagnosis can be made by direct laryngoscopy. Usually a chondroma protruding into the lumen will show as a smooth, hard, rounded mass, covered with mucosa of unchanged appearance. Ulceration has never been reported. Because of the hardness of the mass a satisfactory biopsy may be difficult to obtain. As soon as the tumor increases in size the amount of deformity increases, and there is distortion of the outline of the glottic chink depending upon whatever portion of the lumen it encroaches.

If the tumor is protruding externally, external palpation with delicate sense of touch will determine whether or not a cartilaginous tumor is attached to or springs from one of the laryngeal cartilages. When a mass is palpated in the neck, it should move with movement of the larynx and, conversely, ballottement of the cervical mass should cause the intraglottic mass to change its position. Free

motility of the mass, its pallor and firm texture are almost diagnostic to the examiner who is familiar with gross pathologic characteristics of this tumor.

Tobeck⁸ stressed the importance of roentgenographic examination and recommended that both lateral and anteroposterior views be taken. The roentgenogram is particularly instructive if there is calcification or ossification of the tumor. In the two cases presented in this paper, the tumors were well outlined by the above views. Tomographic studies of the second case were very helpful in the delineation of the tumor.

Figt⁹ stressed the significance of the appearance of the blood vessels which stand out prominently in the apparently normal mucous membrane covering a smooth sessile mass.

Treatment.—Currently it is believed that the only proper treatment for this condition is surgical removal. It is necessary to excise every fragment of the tumor with a fairly wide margin in order to avoid recurrence. All cartilaginous tumors regardless of size or location should be removed, if possible, as soon as the diagnosis is made, for there is always a small percentage that will take on malignant characteristics.

In chondroma and chondrosarcoma of the larynx tracheotomy is, of course, indicated as a precautionary measure whenever the patient shows any signs of cyanosis and dyspnea, and should be done low. Tracheotomy is usually done routinely whenever any form of laryngeal surgery is performed which may result in postoperative laryngeal edema, and especially whenever any part of the framework of the larynx is sacrificed. Endolaryngeal removal by direct laryngoscopy should be limited to tumors which are small and accessible. When the tumor is attached to the cricoid cartilage, laryngofissure with complete removal is the method of choice. If it arises from the thyroid cartilage it may be removed by an external approach and submucous resection or morcellation without removing any of the laryngeal mucosa. If morcellation is the operation selected, great care should be taken to see that the tumor bed is well curetted.

Total laryngectomy should be strongly advised in cases in which the larynx is obliterated and it is impossible to carve a new larynx from the tumor mass, and in those cases where the tumor has become so large that its removal will sacrifice the framework of the larynx and result in collapse and stenosis.

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In our case of true chondroma the entire cricoid cartilage was removed, half of the cartilage being removed in 1938 by Dr. John D. Kernan and the other half in 1944. At no time after the second operation did the patient show any evidence of laryngeal stenosis. The stenosis in this case may have been prevented by the thick capsule which was found surrounding the tumor mass at operation.

Rosedale in his case sacrificed half of the cricoid cartilage and half of the first two tracheal rings and then used a prosthesis to prevent stenosis. Several articles have appeared where tracheal rings have been removed and acrylic molds or glass tubes have been used to prevent stenosis. Longmire,¹⁰ in a recent article, presented a case of a ten-year-old boy whose cervical trachea had been avulsed two years previously. In this case he used a lucite tube which was left in place ten and a half months to permit the tracheal wall to become as rigid as possible in order to prevent subsequent contraction.

In the series of cases reviewed by Moore, operation was performed in 39, of which nine were laryngofissures and six total laryngectomies. In McCall's review there were ten laryngofissures and eight total laryngectomies. In Rosedale and Moore's cases laryngofissures were done. Up to this report there have been 21 laryngofissures and 14 total laryngectomies performed for chondromas of the larynx. In the case now presented in this paper a laryngofissure was performed.

It cannot be overemphasized that the only form of therapy for chondrosarcoma which nowadays offers any prospect of cure is surgery and that surgical treatment should be definitely of the radical type. The wider the margin of supposedly normal tissue, the better. A radical procedure offers the best promise of success when it is undertaken at the initial intervention. The second case in this paper is an example of incomplete removal at first operation with recurrence in 17 months.

Irradiation therapy is hardly of any value since this type of tumor is highly resistant to such treatment. The growth continues or resumes in spite of it. Irradiation may serve at most as a palliative agent for a chondrosarcoma in a site inaccessible to surgical intervention and should not be used with any higher expectations.



Fig. 1, Case 1.—Lateral roentgenogram showing the encroachment of the soft tissue mass upon the posterior margin of the air column and the tiny deposits of calcium scattered throughout the tumor mass.

REPORT OF CASES

CASE 1.—*Chondroma of Cricoid Cartilage*.—A 53-year-old white male, a physician, was first admitted to the Ear, Nose and Throat Service as a private patient of Dr. John D. Kernan on April 26, 1937, at which time he gave a history of interval hoarseness for two and a half years.

Physical examination showed a well developed white male. The examination of the heart showed a systolic murmur over the apex area. The blood pressure was 132/80. Indirect mirror examination of the larynx showed an elevated, irregular area at the junction of the middle and posterior third of the left vocal cord. On direct laryngoscopy biopsy was taken from the above area and was reported as polyp of the vocal cord.

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The patient was then followed as an out-patient and on March 14, 1938, x-ray examination of the larynx and soft tissue of the neck showed a soft tissue mass somewhat fusiform in outline and containing numerous tiny deposits of calcium, extending along the posterior border of the larynx down to the level of the cricoid cartilage. It seemed to displace the trachea forward and slightly to the right. Roentgenographic diagnosis was that of a cartilaginous tumor of the cricoid cartilage.

The patient was readmitted on June 1, 1938, at which time he stated he had had continued hoarseness and an increase in the size of the external mass. Physical examination at this time was essentially the same as on the first admission, except for the laryngeal findings. Externally there was a smooth hard mass definitely attached to the laryngeal structures extending along the left side of the neck from the level of the hyoid bone to approximately the level of the second tracheal ring.

On indirect mirror examination of the larynx the mucous membrane was approximately normal in color. There was no movement of the left arytenoid and the left vocal cord had a gray-red appearance and lay near the midline. The right vocal cord was normal. There was a large, firm, red, smooth mass that appeared to have its origin on the left side. The mass occupied about one-quarter of the tracheal lumen.

On June 1, 1938, a laryngofissure was performed and the mass was found to be localized to the left side of the cricoid cartilage. An attempt was made to remove the left cricoid ring and tumor in toto, by cutting the cricoid cartilage in the midline anteriorly and dissecting the mucous membrane free from the cartilage. This was unsuccessful, however, and the cricoid cartilage and the tumor mass were removed piecemeal with various sizes of Spratt's curettes. A tracheotomy was done as a precautionary measure.

The patient had a febrile postoperative course for two weeks as the result of secondary infection of the wound. He was discharged from the hospital on the thirty-seventh postoperative day with the tracheotomy tube in place.

The pathological report on the specimen obtained at operation stated: "The microscopic section is composed almost entirely of hyaline cartilage which stains rather poorly. It appears somewhat embryonic in type.

"This is a well differentiated chondroma without any collagen or elastic tissue in it. There is no histological indication of malignancy but these tumors sometimes display infiltrative growth, and if excision has not been complete, the remnants may continue to grow.

"Diagnosis: Chondroma of cricoid cartilage."

The patient was readmitted to the hospital on May 16, 1939, at which time his only complaint was his inability to breathe without the tracheotomy tube. On direct laryngoscopy the entire larynx was found to be swollen. On passing a 9-mm. bronchoscope a small nodular mass was seen in the area of the thyroid cartilage and cricoid cartilage on the left side. The mass was removed for biopsy and was reported as chondroma of the larynx with no evidence of malignancy.

His next admission was on March 23, 1944, at which time there was a firm mass obstructing the subglottic area. At operation the incision was made at the anterior border of the right sternocleidomastoid muscle. With large curettes the cheesy material was scooped out of the cricoid cartilage. During this process the entire cricoid cartilage was removed.

The pathological report was chondroma of the larynx.

The patient had an uneventful postoperative course and the tracheotomy tube was removed prior to his discharge. During the next six months he was admitted to the hospital several times for direct laryngoscopy and during this period the lumen was never smaller than a No. 38 French sound.

This patient has now been followed in the office since 1945 and there has been no evidence of any local recurrence or laryngeal stenosis.

CASE 2.—*Chondrosarcoma of Cricoid Cartilage.*—This patient is a 40-year-old negress who was first admitted to the Ear, Nose and Throat Service on June 29, 1948, at which time her main complaint was that of loss of voice and a progressive enlargement of a mass in her left neck. She stated that in March, 1947, at another university hospital in another city she had had a small tumor removed from the left side of her neck. During the operation a tracheotomy

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Fig. 2, Case 2.—Lateral photograph showing the size of the tumor.

was performed and she had been unable to get along without the tracheotomy tube since that time.

Examination of the neck revealed a bony, hard mass 5 by 5 cm. overlying the left thyroid cartilage, fully movable under the skin but constituting a part of the larynx. She had a No. 5 tracheotomy tube in situ.

On indirect mirror examination of the larynx there was no movement of the left arytenoid nor of the left vocal cord. The glottic chink was very narrow. No ulcerations nor masses were seen.

The blood pressure was 184/80; the pulse rate 120. There were no heart murmurs and the rhythm was regular. No enlargement of the heart was perceived on percussion.

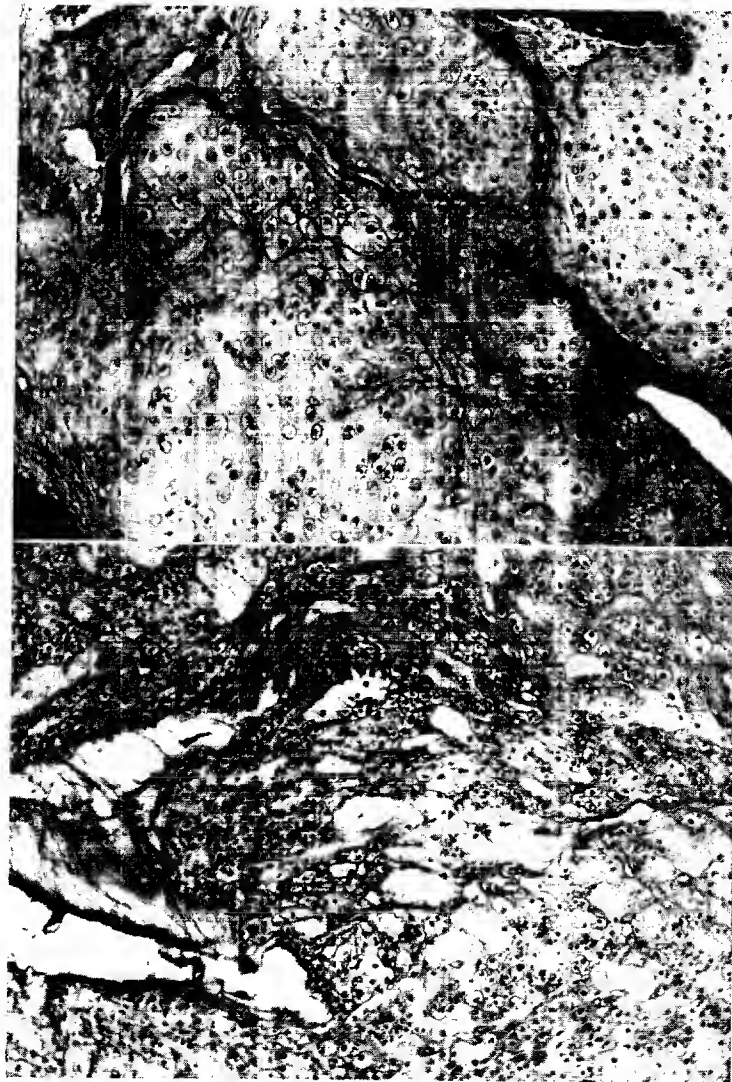


Fig. 3, Case 2.—Photomicrographs showing (top) an area of immature atypical cartilage area of the tumor and (bottom) a moderately well differentiated area of the tumor. (Hematoxylin and eosin; $\times 180$).

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On June 29, 1948, a direct laryngoscopy was performed and a paralysis of the left vocal cord was confirmed. In the left subglottic area a hard, round mass was seen. There were no ulcerations. No biopsy was taken. X-ray examination of the chest was negative. Sedimentation rate was 47 mm./hr., hemoglobin was 11.9 gm. and the red blood count 3,700,000. Postero-anterior and lateral stereoscopic films of the neck and tomographic studies taken at 12, 13, 14, 15, and 16 cm. showed a large soft tissue mass arising from the region of the cricoid cartilage. The mass extended posteriorly and to the left, displacing the esophagus and the proximal end of the trachea to the right. The tracheal air column was almost completely obliterated.

In the meantime an abstract of the findings from the other hospital was received and summarized as follows:

The patient is a 39-year-old negress who was admitted to General Surgical Service because of a lump in the left side of the neck, and dysphonia, especially for the high notes, of eight months' duration.

Examination showed a round mass about the size of the tip of the little finger, attached to the inferior cornua of the thyroid or cricoid cartilages. The mass was firm, smooth, and nontender. Roentgenograms of the heart, lungs and neck were negative.

On March 28, 1947, the patient had been taken to the operating room and an attempt at endotracheal intubation made, but this was unsuccessful due to an obstruction just below the vocal cords. Anesthesia without intubation was then carried out and the operation was performed, exposing the tumor, approximately 2 cm. in diameter, arising from the cricoid cartilage. In an attempt to remove this, the trachea was entered and it was felt that some tumor mass was left in the inner surface below the vocal cord. A tracheotomy was performed. The patient had an uneventful postoperative course and she was discharged from the hospital on the twelfth day with the tracheotomy tube in situ. She was given an appointment to return to the Ear, Nose and Throat Department with regard to possible removal of the tracheotomy tube and evaluation as to the need for future operation on the tumor.

The pathological report from the other hospital stated: "The frozen section examination of the tissue obtained at operation reveals numerous isolated and small clumps of cells characterized by irregular

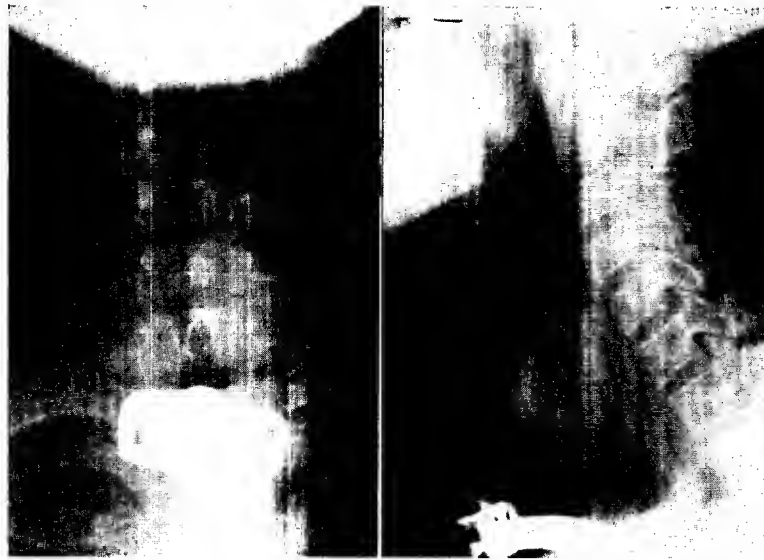


Fig. 4, Case 2.—Anteroposterior and lateral roentgenogram showing, in the first, almost complete obliteration of the tracheal air column and in the second, the large tumor mass extending posteriorly.

hyperchromatic and small nuclei, and clear nongranular cytoplasm. These cells are identified as chondrocytes and are embedded in a matrix resembling hyaline cartilage. There is no anaplastic character to these cells and their arrangement, although they appear distinctly irregular and double nuclei are frequently seen.

"The permanent sections add no further information. We are classifying this tumor as a chondroma on the basis of the presence of a capsule, and of osteoid tissue and the absence of any extremely irregular and anaplastic characteristics of the chondrocytes. It is felt, however, that a diagnosis is to be made with many reservations because the tissue is not the usual type of cartilage and many of the chondrocytes exhibit some degree of irregularity and double nuclei.

"Diagnosis: Chondroma of cricoid cartilage."

The pathological specimen forwarded with the abstract was examined by our Surgical Pathology Department and the following report was made: "Sections show a cartilaginous growth in which

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there are areas of ossification. The matrix of the cartilage cells vary somewhat in appearance. Most of them have small nuclei, however, and in several places are more cellular areas with darkly staining plump nuclei which almost fill the lacunae. In addition there are fields in which the lacunae contain two or more nuclei. No mitotic activity is observed. In some areas the cartilaginous growth appears to extend into the fibrous capsule.

"Some of the above mentioned features, namely, the more cellular areas with plump nuclei, the lacunae with two or more nuclei and the giant multinucleated cartilage cells are regarded as signs of a probable malignancy.

"Diagnosis: Chondrosarcoma (?) of cricoid cartilage."

On August 20, 1948, the patient was prepared for lowering of the tracheotomy tube and for removal of the tumor mass. While performing the tracheotomy under local anaesthesia the pulse rate gradually rose to 200 so that operation on the tumor was postponed.

A complete medical work-up was performed including radioactive iodine studies and the unexplained sinus tachycardia persisted.

On September 2, 1949, under general anesthesia, through a horizontal incision it was found that the lower half of the left thyroid cartilage and four-fifths of the cricoid cartilage was replaced by a tumor the size of a golf ball. The tumor was well localized and did not invade the laryngeal mucosa. By blunt dissection the underlying laryngeal mucosa and posteriorly situated hypopharynx and thyroid gland were separated from the tumor. A separate segment of adjacent tracheal mucosa was secondarily sacrificed because of its adjacency to the inferior tumor margin.

The subglottic laryngeal defect was repaired by a free graft from the thigh. It was sutured to the adjacent laryngeal mucosa and held in place by a rubber tube fitting the laryngeal lumen.

The pathological report of the specimen obtained at operation stated: "The microscopic sections reveal that the tissue is composed principally of a cartilaginous matrix with a few scattered bony trabeculae. The chondrocytes vary in size, are usually oval to round, and many show chromatic plump nuclei. The cells sometimes do not fill

the cartilage capsules and a few multinucleated cells are seen. No mitotic figures are seen. The usual territorial arrangement of the cartilage cells is lost, the cells being diffusely and haphazardly scattered throughout the stroma. A fibrous capsule surrounds the cartilaginous tumor, but this appears to be invaded by tumor at one point.

"Diagnosis: Chondrosarcoma of cricoid cartilage."

On the fifteenth postoperative day the rubber tube was removed from the larynx through a laryngeal speculum. Attempts to close off the tracheotomy tube were unsuccessful as the patient tolerated the corking poorly. On September 28, 1948, direct laryngoscopy was performed and laryngeal dilators up to size No. 32 were passed without difficulty but upon their withdrawal there was a collapse of the laryngotracheal lumen.

Because of the collapse of the laryngeal structures it was felt that a total laryngectomy would eventually be necessary. In view of the patient's persistent tachycardia it was thought that the operation should be postponed until her general condition improved. On October 11, 1948, the patient was discharged from the hospital to be followed in the laryngeal clinic.

On the first clinic visit on October 27, 1948, it was felt that the glottic chink had increased in size although some fullness persisted below the cord.

SUMMARY AND CONCLUSIONS

Cartilaginous neoplasms of the laryngeal cartilages are comparatively rare. Two cases, chondroma and chondrosarcoma, have been presented and discussed from the standpoint of site, pathology, symptoms, diagnosis, and treatment. In discussion on microscopic differentiation between benign and malignant cartilaginous tumors, Lichenstein and Jaffee believe that a cartilage tumor should no longer be regarded as benign if, when viable and not heavily calcified areas are examined, it shows even in scattered fields (1) many cells with plump nuclei, (2) more than an occasional cell with two such nuclei, and especially (3) any giant cell with large single or multiple nuclei or with clumps of chromatin.

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The only treatment for these neoplasms is surgical excision and in general the same as that for any tumor. It is essential to remove every fragment of the tumor with a fairly wide margin in order to avoid recurrence.

Microscopic reports and pathological photographs were prepared by Dr. Raffaele Lattes, Assistant Professor of Surgery, College of Physicians and Surgeons, Columbia University, New York City.

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VIII

SOME PHYSICAL PROBLEMS IN CONDUCTION DEAFNESS

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Most of our concepts about the acoustic response of the healthy and the diseased conduction apparatus are based on indirect evidence. Measurement of distant effects such as the auditory threshold in man,¹⁻⁷ cochlear microphonic⁸⁻¹⁰ nerve action potential, middle ear muscle reflex and the conditioned response are examples.

On the other hand, direct observations upon the vibrating structures themselves have been limited. Earlier methods for making direct observations (stroboscopic, optical, etc.) were insensitive and limited in range. In recent years many methods have been developed by Békésy¹¹ for studying the physical phenomena produced in the ear by acoustic stimulation. Electronic means for detecting minute acoustic displacements used by physicists have been adapted¹² to the special conditions prevailing in the ear.

Such direct observations are important not only in clarifying normal function but in helping the otologist to understand variations due to disease as reflected in the threshold curve. Using fresh cadaver ears a wide variety of conduction lesions can be investigated in this manner.

The experiments reported here were restricted to the study of the vibrations of the ear drum and of a rubber diaphragm in models under several simulated pathological conditions.

Temporal bones were removed at autopsy and preserved in a cold, moist chamber with 1/4000 aqueous merthiolate to prevent bacterial growth. In this manner the elastic properties of the conduction apparatus could be maintained for many months. While some of the observations were made on specimens immediately after

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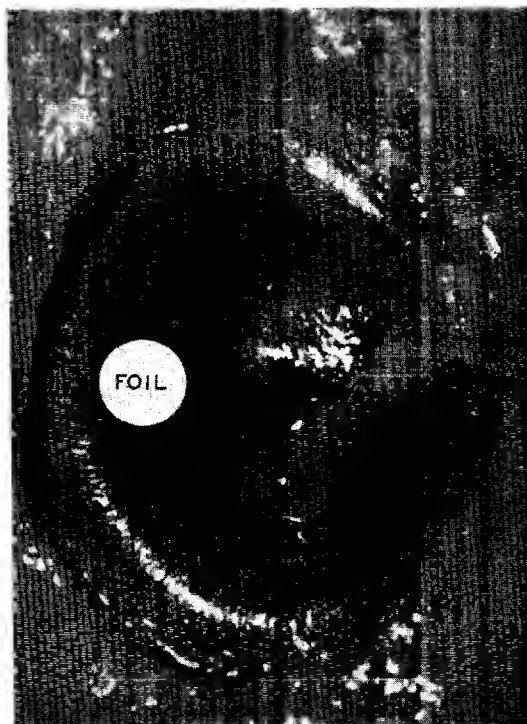


Fig. 1.—Approximate relation of foil area to total drum surface. Foil is just below and posterior to the incudostapedial articulation as seen through the thin pars tensa. The curved band of light below the umbo and near the annulus marks the site of maximum drum curvature.

removal at autopsy no appreciable alteration in response was observed in properly preserved specimens. Furthermore with the procedures adopted, long periods of observation were possible at each experimental session without alteration in the response curve due to drying. The dissection was carried out to expose the part to be studied. In this case the drum area was exposed and a piece of metal foil about 2 sq. mm. was made to adhere to the surface with a spot of vaseline (Fig. 1 and 2). The pick-up arm firmly fastened in a vise was then advanced until the end of the probe was less than 1 mm. away from the foil. The sensitivity is not critically dependent on spacing between probe and foil over a rather wide range, although this spacing can be determined by electrical measurement. To prevent artefacts due to the acoustic vibrations of rods and clamps

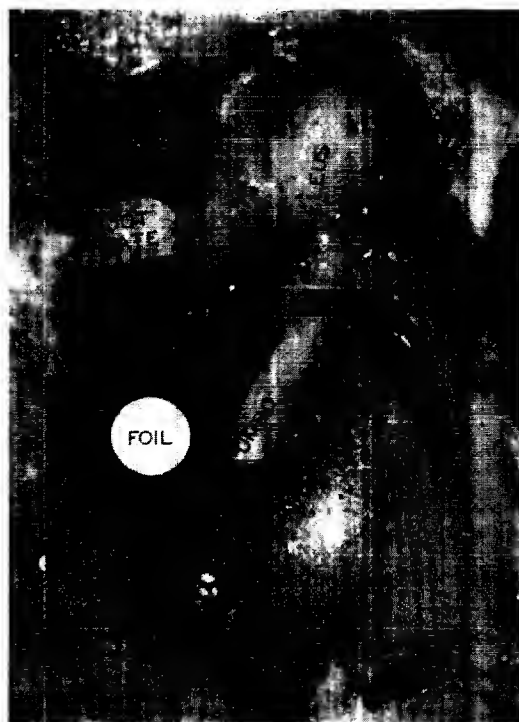


Fig. 2.—Inner surface of drum with ossicular chain indicating the size of the foil relative to the stapes footplate and drum.

the bone was buried in a mass of modelling clay exposing only the part to be studied. Both the vise holding the probe and the block of clay carrying the specimen were mounted on a heavy metal plate. The plate was supported by special mounts that absorb the vibrations of the work table upon which it stood. Sound was delivered from a loud speaker adjacent to, but not in contact with, the specimen and the intensity of the stimulus was measured with a calibrated condenser microphone and probe tip at the drum. Equipment used in earlier experiments¹² was not sensitive enough to obtain a signal from drum movements at moderate sound pressures. Original experiments were therefore conducted by delivering relatively intense sound through tubing sealed in the external canal. This very strong acoustic stimulus was able to induce sufficient movement of the middle ear elements to permit detection by our pick-up unit. The working end of the original probe was larger in diameter and

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required a larger foil area, thus interfering with proper placement of the foil and the probe. After careful elimination of spurious vibrations it is possible with our present equipment to obtain a signal corresponding closely to the vibration of the part to which the foil adheres. A moderately intense acoustic stimulus (of the order of 80 db. re 0.0002 dyne/cm.²) can produce sufficient oscillation of the drum so that a clear signal can be obtained from the pick-up device and presented upon the screen of a cathode-ray oscilloscope. The amplitude and wave shape can both be studied on the screen. For still greater sensitivity the obtained signal can be fed into a wave analyzer and a direct voltage reading of the signal obtained for the frequency of the presented stimulus to the exclusion of the wide band of electrical "noise" background inherent in all vacuum tube operation. After proper arrangement of apparatus, sounds of constant pressure were presented as measured on a Ballantine voltmeter activated by a calibrated condenser microphone and pre-amplifier. Response to frequencies from 200 up to 10,000 cycles was usually explored at about octave intervals, although response at the higher frequencies is considered significant only for comparative purposes due to the effects of the short wave lengths. The scope was observed for the signal and wave shape and the amplitude recorded.

RESULTS

A variety of initial response curves was obtained from the posterosuperior portion of the drum. These usually showed an amplitude more or less peaked at about 1000 cycles. The response at the umbo, however, was more uniform (Fig. 3). When the preparation was allowed to dry for several hours the resonant amplitude peak shifted to a higher frequency (Fig. 4). This could be reversed by wetting the preparation. The extreme degree of resonant frequency change was observed in specimens that were allowed to remain exposed to room air for many weeks. The entire bone became very dry, the drum was parchment-like and the ossicular chain was fixed to static displacement. The posterosuperior portion of the drum was now found to be very insensitive at ordinary frequencies but showed a marked amplitude peak in the vicinity of 14,000 cycles. Such a specimen could be altered by wetting and by returning it to a moist chamber. The frequency response of the drum would then be found to peak at a considerably lower frequency with definite improvement in overall sensitivity. Changes in fre-

quency response of the posterosuperior area of the drum were produced by varying degrees of drying and by pulling on the suitably isolated tensor tympani muscle. Responses obtained from the posterosuperior quadrant of the drum typically exhibited an amplitude resonance between 1000 and 2000 cycles, above which the amplitude fell off rapidly.

The other main group of experiments were concerned with changes in drum vibration when the middle ear contained fluid (normal saline). Some difficulty was encountered in sealing the fluid within the middle ear and in making complete fillings without air bubbles. In other experiments the middle ear was only partially filled with saline. In general the alterations in vibration of the drum were striking in these acute experiments. Reduction in the peak amplitude of vibration and a change in its frequency was uniformly and repeatedly produced. There was a marked reduction in the response to high frequencies and often a relative improvement of the response to low frequencies. The amplitude resonance peak was shifted towards the low frequencies (Fig. 5, 6, 7 and 8).

DISCUSSION

One must proceed with caution when interpreting the results obtained on vibration of the posterosuperior area of the drum since the vibration of the malleus is known to differ from the vibration of this area, particularly at the higher frequencies. Further, while the vibration of the malleus rather faithfully follows that of the central area of the drum, by the time the stimulus reaches the stapes footplate it is affected by the action of the intervening ossicles with their middle ear muscle attachments. Using a "capacitative probe" Békésy¹¹ found that in an intact ear exposed to sound of the same pressure the drum vibrates together as a conical piston with uniform amplitude up to about 2000 cps. Furthermore, above 2400 cycles the malleus does not faithfully follow the drum vibration but appears to lag behind it. At these high frequencies the drum loses its rigidity as a piston and vibrates as a stretched membrane. Nevertheless, given a certain alteration in drum vibration a similar type of alteration might be expected in the stimulus reaching the footplate. Békésy observed a selective effect on pressure transformation from the drum to the footplate when the middle ear air pressure was changed to + or -10 cm. of water. That this was not due to simultaneous pressure on the oval and round window was evident

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because the stapes was immobilized by a counter acoustic stimulus at the same time the measurements were made. He thought that this effect on the pressure transformation at the footplate was the result of a change from a pistonlike action of the drum to that of a stretched membrane, which produces less pressure transfer by the drum through the ossicular chain to the footplate. The reduction in pressure transfer concerned only the low frequencies (up to about 800 cycles) and there was little effect above 1000 cycles. A similar degree of loudness change is produced in man under these conditions.

Békésy observed overtones in the vibration of the footplate only when the acoustic pressure at the drum was near the level of feeling. For the sound intensities used in our experiments, the vibration of the points on the drum which were studied was essentially sinusoidal.

Békésy found that the sound pressure per sq. cm. at the footplate needed to immobilize it, divided by the driving sound pressure per sq. cm. at the drum, indicated a normal pressure increase at the footplate of 10 to 20 times up to 2000 cycles. This was a little higher around 2000 cycles (30 to 40 times that of the drum) when the sound pressure was measured not at the drum but at the opening of the external canal because of the resonance effect of the canal itself. Opening the middle ear or cutting the tensor tympani produced no change in this pressure transfer from drum to footplate. Most of our measurements on drum vibration were made after the external canal was largely removed to permit an approach of the probe tip. Hence the effect of canal resonance does not come into consideration in our findings. Our investigations were not directed towards exploration of the vibrating drum surface for points of maximum and equal amplitude. A single placement of the foil, usually in the upper posterior quadrant, was used while studying the effect of a given lesion.

We have not repeated the observations of Békésy on vibration amplitudes of various parts of the drum. He found that maximum amplitude occurs in the markedly curved fold of the drum near the annulus and below the umbo (see Fig. 1). This curved fold permitted the drum to yield as a unit, covering about 55 sq. mm. of the total drum area of 85 sq. mm. and (below 3000 cps.) to vibrate as a conical piston with its attached malleus, through an axis near the top of the drum. Our observations with a stroboscope clearly show this piston-like nature of the acoustically vibrating drum at 180 cycles. However, some additional motion between the umbo

and the periphery is seen, especially in the posterosuperior quadrant of the drum where there is a greater distance of drum between umbo and annulus. Békésy points out that the shape of the deformity of the drum to a point pressure is circular as is the shape of the artificial perforation. This indicates uniform forces in both radial and circular direction. To permit overall flattening of the arched periphery of the drum towards the central umbo, differences between circular and radial fibers should be present, and should appear as deviations from the circular shape to pin point pressure and to perforation into an oval shape parallel with the direction of the radial fibers.

Therefore the amplifying effect on the malleus due to this type of preferential deformity of the drum fibers as claimed by Helmholtz is discounted by Békésy and the pressure transferred to the footplate is said to be dependent only on differences in effective areas of the two pistons and the small lever factor of the ossicles, 1.3 (see Fig. 2). The drum and malleus response is not appreciably altered by severing the axis ligaments, according to Békésy, indicating that the center of gravity of the ossicular masses is at this same region to permit effective oscillation without the ligaments. Below 200 cycles, however, the absence of the ligaments results in erratic oscillation of the chain. The ligaments are not needed to maintain the turning axis of the ossicles for high frequencies. The reduction in pressure transfer below 200 cycles is the result of interaction of the ossicles with the axis ligaments. The pressure transfer is unstable below 200 cycles when the axis ligaments are cut. At these lower frequencies where the mass effect is smaller, the turning axis is firmly controlled by the axis ligament. We observed that the elastic character of the drum together with its conical shape is altered when the anterior ligament of the malleus is detached, so that the frequency response of such a unit is that of a mass controlled system. This is also true of the drum, detached from the annulus in its upper third, with malleus head amputated (see Fig. 8, graph 2). On the other hand the conical shape is preserved when the anterior ligament remains but the drum vibration is mass controlled. With the incus in place, the acoustic vibrations are changed to resemble the response of the intact system which is stiffness controlled over a considerable frequency range. Freeing of the incus at the fan-shaped ligament itself does not appreciably alter the vibration characteristics of the chain as observed at the drum and malleus head (see Fig. 7, graph 5). Békésy¹³ reports that for constant sound pressure at the drum the vibration amplitude or the displaced volume

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of the round window is about the same for frequencies up to 3000 cycles. The volume displaced by the associated movement of the cochlear partition is therefore also constant through this frequency range. However, for the lower frequencies (100 cycles) a greater length of the basilar membrane is moved than for the higher frequencies (1500 cycles). Therefore a longer length of the reacting basilar membrane must move with a smaller amplitude to equal the volume displaced by a shorter length of the basilar membrane. This smaller amplitude results in less stimulation of the hair cells which may account for the lower sensitivity of the ear at low frequencies¹⁴. Phase studies at the round window indicate that the whole system together operates as an elastic system at low frequencies and that a strong resistance enters at high frequencies.

Resonances at 600 and 1200 cycles were often seen by Békésy, however, but were not presented in his curves.

Phase studies indicate an 800-cycle resonance for the coupled system and a 1400-cycle resonance for the labyrinth fluid with the round window but without the footplate. With both windows the system seems elasticity controlled except at high frequencies. Without the windows, however, the vibration of the labyrinth fluid appears to be friction or mass controlled. Békésy found that only a great increase in labyrinth fluid pressure affects the vibration amplitude of the round window.

Other recent observations help the otologist to visualize the changes in vibration of the conducting system in middle ear disease and help to clarify the role of the round window in hearing under normal and pathological conditions.

Lowy¹⁵ observed that mineral oil in the middle ear affected the phase of the cochlear microphonic as well as the amplitude, the phase lagging the stimulating sound pressure below 1000 cycles and leading above 2000 cycles. He explains this primarily on the basis of an increased resistance or damping of the conduction mechanism because of the oil. A primary increase of mass would result in a phase lag throughout the entire frequency range while a primary increase in stiffness would result in a phase advance over the initial condition. He produced the latter condition by pressure on the malleus with a fine wire. Since mineral oil in the middle ear showed both a phase lag through the lower frequencies and a phase advance

in the higher frequencies, an increase of resistance or damping was considered to be the major alteration in the system.

Lowy¹⁶ observed differences between the effect on the cochlear microphonic of a cotton pledget tightly pressed against the stapes and a drop of mercury on the oval or round window. The latter improved only the low frequency response of the cochlear microphonic and impaired the high frequency response (over 4000 cycles). This was explained as due to an increase in the effective mass of an acoustically vibrating system which improves its response below resonance and impairs its response above resonance. On the other hand a cotton pledget pressed against the stapes in the oval window improved the high frequency response. This was explained as due to an increase in the stiffness of the oval window.

Experiments on the effect of pressure and weighting of the round window membrane as reflected in the cochlear microphonic were recently reported by Wever and Lawrence¹⁰. They observed very little effect on the cochlear response when a probe was pressed against the round window membrane. Air pressure against the round window membrane up to 25 mm. of mercury was also ineffective in changing the mechanical function of the intact system as reflected in the microphonic output. This experiment requires that the round window be completely isolated from the rest of the middle ear by tubing. This isolation does not appear to affect the output of the cochlear microphonics. Similarly Békésy isolated the round window in order to measure its volume displacement in response to sound in the external canal. A wax plug or a drop of mercury against the round window membrane did impair the cochlear microphonic for the high frequencies by about 4 db. With the chain removed (except stapes footplate) and sound delivered by tubing to the oval window, blocking the round window with wax did not effect the high frequency response but did impair the low frequency response (around 100 cycles). These workers considered that with the intact system a plug of wax against the round window caused an overall increase in the mass of the vibrating system and hence a high frequency impairment, while with the chain destroyed putting a wax plug against the round window caused an overall increase in the stiffness of the vibrating system and hence a low tone impairment in the cochlear microphonics. The already great stiffness added by the conduction apparatus to the cochlear system is not changed appreciably by the plug against the round window membrane.

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The otologist is largely dependent on the interpretation of threshold curves in evaluating functional losses. One is continually challenged to find the factors that determine the shape of this threshold curve. The systematic investigations of Békésy have helped greatly in developing a clear picture of the purely mechanical phenomena in the ear as separate from the neural phenomena and throws new light on the normal sensitivity curve.

In addition to the difficulties in explaining the normal sensitivity of the ear, changes in sensitivity with ear disease have to be considered. Alteration in the vibrating condition of the drum is a relatively simple problem to study. The direct evidence that the drum oscillates to a wide frequency range of sounds has only recently been obtained. Békésy reported on drum vibrations up to 3000 cycles. However, such methods permit observations of vibration through an even larger part of the auditory spectrum and reveal that under certain conditions vibrations of certain areas of the drum at 14,000 per second and higher can be detected. Clinical examples producing fundamentally different conditions for drum vibration are found and can be produced experimentally in the living subject (Fig 9). Alterations in air pressure between the two sides of the drum, associated with tubal obstruction or inflammatory reactions in the middle ear are examples. While alterations in the vibrating of a flat plate due to changes in stiffness on the one hand and changes in mass on the other have been recorded and are mathematically defined in acoustics, detection and measurement of the altered vibrations of the ear drum have been limited even in the laboratory. Alterations in the vibrations of the drum, reflected in the ultimate stimulus which reaches the cochlea, are measured in the living subject by the threshold curve. Hence it is important to prove in what way experimental lesions simulating clinical states alter the normal response. We see here demonstrated a direct effect on amplitude of drum vibration when the middle ear is filled with fluid. The reduction in response to high frequencies is in the right direction to explain the drop in the air threshold curve at these high frequencies in serous otitis for example. Bone conduction tests through this high frequency range, as with a monochord, further indicate that air conducted stimuli are chiefly involved in this disease.

The hearing impairment most marked through the low frequencies is the more classical picture in middle ear disease. Alterations in the stiffness of the drum, either intrinsic or associated with

stiffness changes in the ossicular chain, might explain this type of hearing loss. A rise in the resonant frequency that is produced by this change shifts the peak of sensitivity toward the high frequency end of the acoustic spectrum. This state was simulated in the experiment. Corresponding alterations in the human threshold curve and in the cochlear microphonics of the animal ear are reported. Differential air pressure and action of the tensor tympani muscle were effective stimuli.

With the introduction of the newer techniques for physical measurements upon the various components of the conduction apparatus one obtains a better understanding of the function of the normal and diseased middle ear. The wide variety and constantly changing procedures advanced to improve hearing in conduction lesions have been based almost entirely on clinical observations. Failure to establish the exact cause of impairment in conduction lesions and to define the acoustical nature of the lesion leads to vagaries in interpretations of observed clinical effects.

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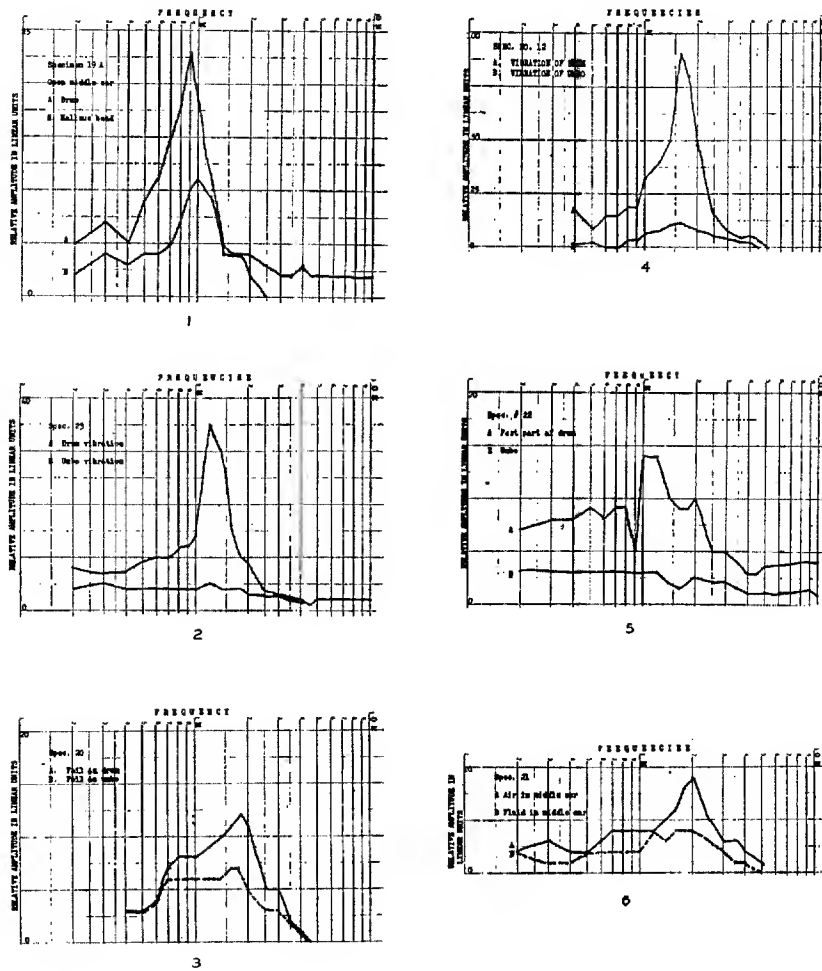


Fig. 3.

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Fig. 3. *Graph 1.* General contour of drum response seen in malleus response.

Graph 2. Obliteration of the resonant peak at the umbo.

Graph 3. Resonant peak of the drum reduced at the umbo.

Graph 4. Umbo response shows overall reduction in amplitude as compared to the drum. This is particularly marked through the resonant area.

Graph 5. Obliteration of drum resonance at the umbo.

Graph 6. Closure of mastoid air cells does not effect drum response.
Fluid in middle ear has greatest effect at 2000 cycles.

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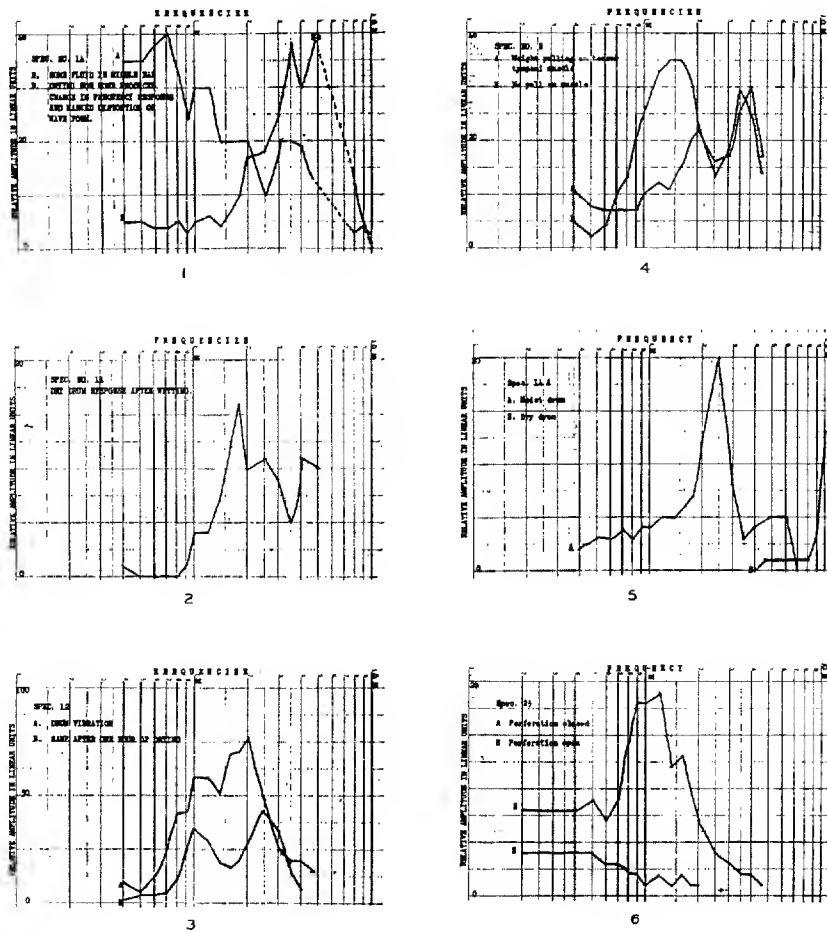


Fig 4.

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Fig. 4. *Graph 1.* Increasing stiffness of drum and chain and reducing the effective mass of the fluid, shifts the resonance peak from 700 to 5000 cycles.

Graph 2. Response of dry drum after wetting. Before this there was no signal through this frequency range but a maximum response at 13,000 cycles.

Graph 3. Increasing stiffness of drum and ossicular chain by drying reduces peak response and shifts peak from 2000 to 2500 cycles.

Graph 4. Pull on tensor increases stiffness of drum and results in a shift of the resonance peak from 1500 to 4000 cycles.

Graph 5. Peak response shifts to 10,000 cycles due to increased stiffness. Signals were obtained in dry state up to 18,000 cycles.

Graph 6. Closure of this perforation produces greatest effect through the middle frequency range.

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Fig. 5. *Graph 1.* Perforated drum response in dry specimen is changed by wetting and closure of perforation.

Graph 2. Fluid in middle ear improves low frequency response and impairs responses at high and middle frequencies. Specimen was then removed from moist chamber for twelve hours, after which period there was very little drum vibration below 4500 cycles.

Graph 3. Drum vibration peaks at 4500 cycles with practically no low frequency signal. This sensitivity is reversed by fluid in the middle ear. (Dashed line indicates no measurement due to insufficient sound pressure.)

Graph 4. Obliteration of resonance peak at 800 cycles with marked reduction above 400 cycles produced by fluid in the middle ear.

Graph 5. Increased stiffness due to drying shifts resonance peak from 3000 to 7000 cycles and reduces response to low and middle frequencies.

Graph 6. Shift in resonance peak with change in the amount of fluid; appearance of an additional resonance peak when more fluid is removed.

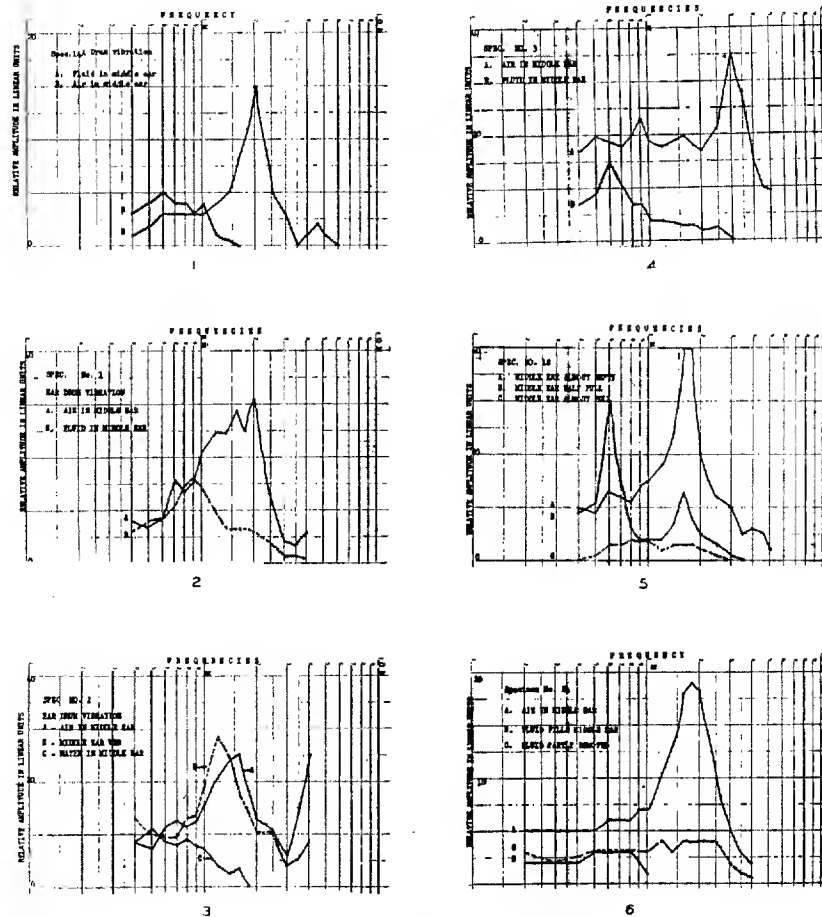


Fig. 6.

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Fig. 6. *Graph 1.* Fluid in the middle ear produces the greatest reduction in drum response through the middle frequency range.

Graph 2. Change in height and position of peaked response due to fluid in middle ear.

Graph 3. A little moisture in tympanic cavity has only a little effect on drum response (curve B). Filling the ear has a marked effect (curve C).

Graph 4. Note shift in resonance peak from 3000 to 600 cycles and the overall reduction in amplitude relatively greater for the higher frequencies when fluid fills the middle ear.

Graph 5. Drop in resonance peak from 1800 to 600 cycles when the middle ear is partly filled with fluid.

Graph 6. Partial restoration of middle frequency response when the fluid in the middle ear is partly removed (curve C).

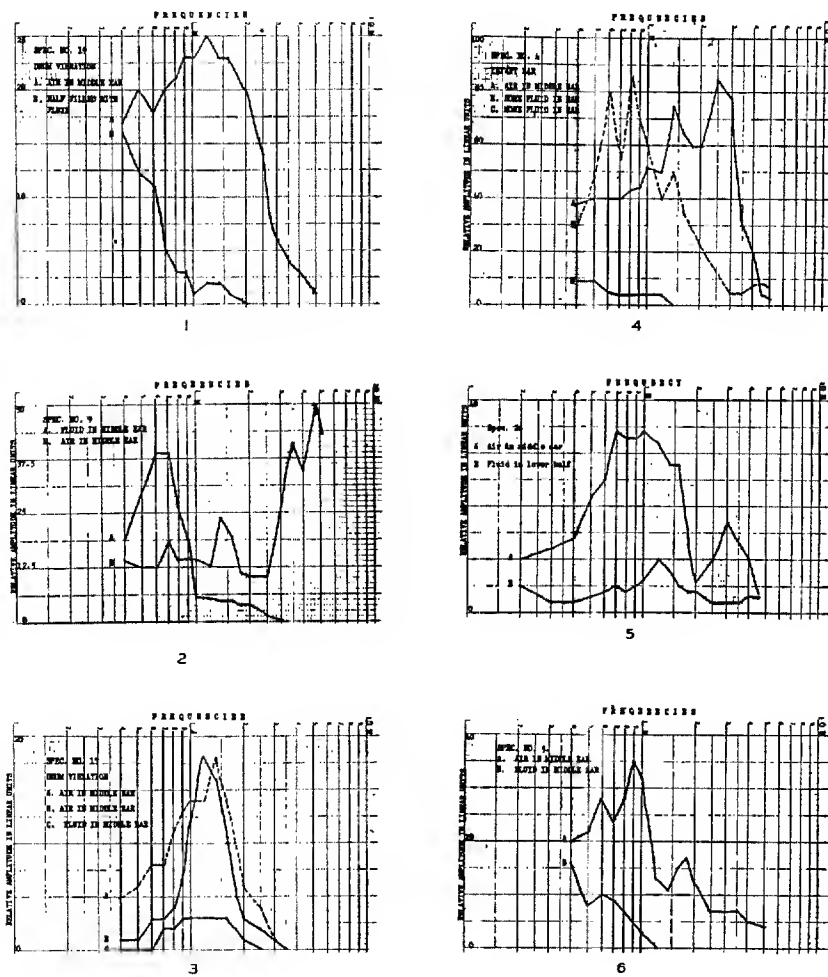


Fig. 7.

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Fig. 7. *Graph 1.* Dried specimen first restored by wetting. Then fluid is placed in the middle ear with characteristic effect on the frequency response of the drum.

Graph 2. Note shift in resonance peak from 4500 to 600 cycles when the effective mass of the drum is increased by fluid in the middle ear.

Graph 3. Curves A and B taken after fluid has been removed from the middle ear. (Small perforation in the drum.)

Graph 4. Note the shift in the resonance peak from 2500 to 800 cycles when some fluid remains in the middle ear (curve B).

Graph 5. Chain intact but fan-shaped ligament of the incus detached. Shape of drum response curve not markedly affected by this lesion (curve A). Fluid in the middle ear has a marked effect (curve B).

Graph 6. Characteristic change in the frequency response curve of the drum when fluid fills the middle ear.

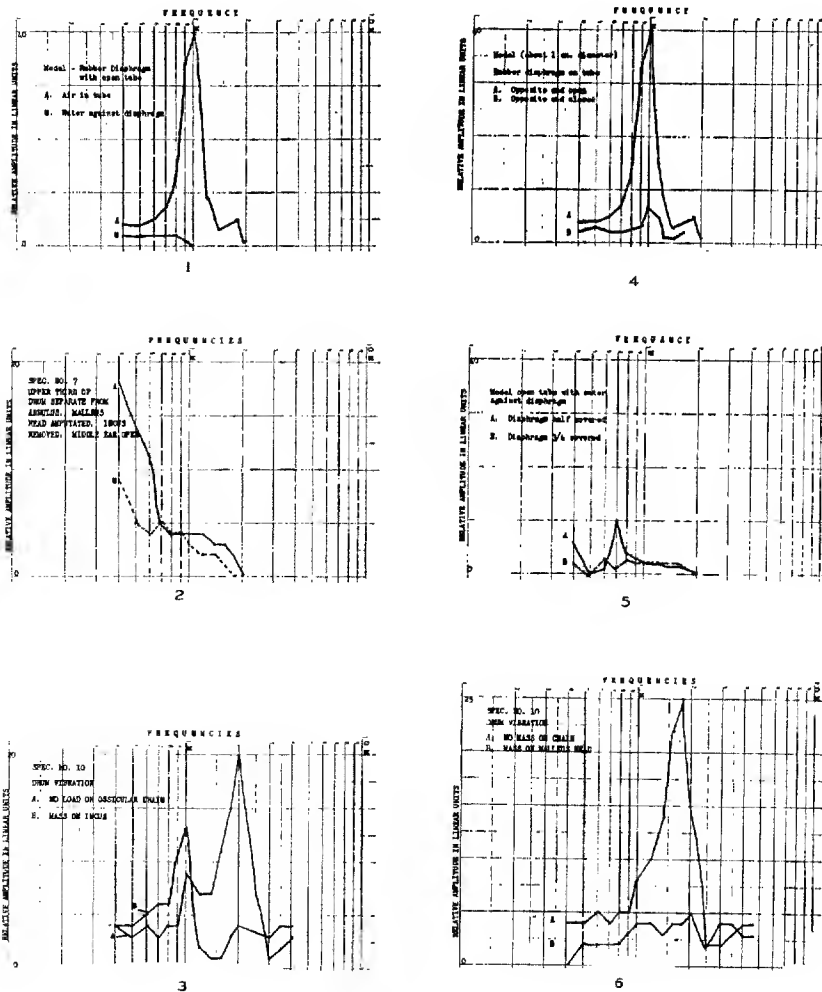


Fig. 8.

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Fig. 8. *Graph 1.* Note similarity in the frequency response curve of a model with air and with fluid against a rubber diaphragm to that of the ear drum with and without fluid in the middle ear cavity.

Graph 2. Frequency response of a partly detached drum without ossicular chain resembles that of a mass controlled system. Fluid against this drum impairs its low frequency response.

Graph 3. Mass on the incus affects drum vibration, shifting resonance peak from 2000 to 1000 cycles.

Graph 4. Closures of cavity behind rubber diaphragm markedly reduces resonance peak. Closed middle ear and mastoid air spaces may contribute to the shape of the frequency response curve of the drum.

Graph 5. With rubber diaphragm of model half covered with water, closure of tube has little effect on frequency response (compare with graph 4).

Graph 6. Mass applied to malleus head affects movement of drum obliterating resonance peak.

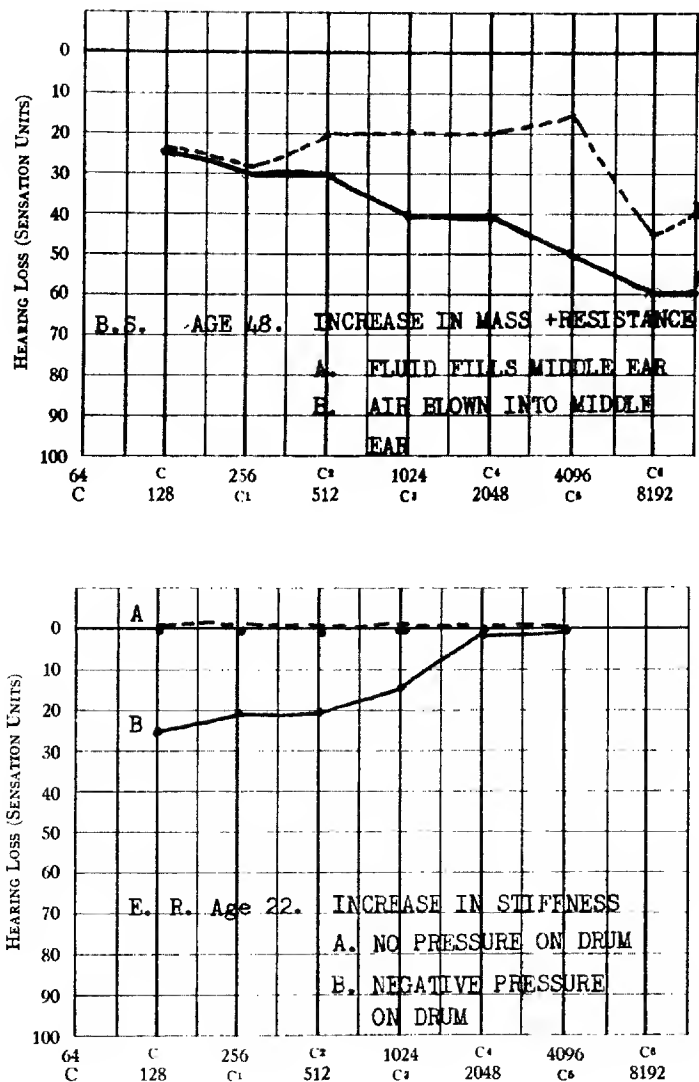


Fig. 9.

Fig 9.—*Graph 1.* Progressive high tone conduction deafness due to fluid in the middle ear.

Graph 2. Progressive low tone conduction deafness due to negative pressure on the drum.

IX

THE OTOLOGIC EFFECTS OF STREPTOMYCIN THERAPY

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In a discussion on streptomycin, an otologist remarked that it was the first of the antibiotics to increase rather than decrease the work in the specialty. He was referring to the toxic effects on the inner ear and the practice of observing the cochlear and vestibular function frequently during the course of treatment.

This is a report of the results of such tests done on 93 patients receiving streptomycin in the treatment of tuberculosis at the Hines Hospital.

MATERIAL AND METHOD

Of the 93 patients all but two were in the special streptomycin study group, one of 20 such groups in the Veterans' Administration.

Before the drug was administered, each patient underwent a complete ear examination. The hearing was tested on a Maico D 4 audiometer in an especially equipped room. While this room is not completely sound proof, it is lined with acoustic tile, and has a heavy, tight door. Air conduction alone was tested. The audiograms were done by a trained Veterans' Administration technician.

The routine for vestibular testing was as follows: The presence of spontaneous nystagmus was noted. The patient's head was placed with one ear up and the canal filled with ice water, about 2 cc., for 45 seconds. The water was allowed to run out, the nystagmus being determined in the two usual positions, head forward at 30 degrees, and backward at 60 degrees. The gaze was fixed with the eyes looking straight ahead at some distant object. The nystagmus was timed with a stop watch from the beginning of stimulation. This rather simple method was suggested by McNally.¹ When performed in this manner, the after-nystagmus in a normal individual lasts from 140 to 180 seconds. Frenzel or other special lenses were not used.

Whenever possible patients were sent for an audiogram and caloric tests every two weeks during treatment and once a month afterward. Subjective complaints were recorded at each visit. The caloric tests were done by different individuals, mainly by the resident otolaryngologists, under the direction of the attending staff.

Since the toxic effect of streptomycin seems related to dosage, the patients were divided into two groups. Group I received 1.8 gm. or 2 gm. per 24 hours in divided doses for four months. Group II received 1 gm. per 24 hours for four months. Since November, 1947, patients starting treatment have been given only 0.5 gm. per 24 hours, but none of the patients in this report were given this lower dosage. All but one received the drug for some form of tuberculosis.

RESULTS

1. *Subjective Complaints.* These were common during treatment and consisted of dizziness, staggering gait, tinnitus, nausea and vomiting and visual disturbances. The latter consisted of inability to read, blurring of distant vision, of objects moving, or of spots before the eyes. A group of 11 patients with eye complaints was studied by Field and Koransky.² They checked the central and peripheral vision, accommodation, convergence and ocular motility. They were unable to find any evidence of disease of the eyes, and concluded the ocular complaints were the result of the vestibular dysfunction.

In Group 1, those receiving 2 gm. per day, 42 of the 53, or 79.2%, had subjective complaints of varying degree. In Group II, those who received 1 gm. per day, 18 of the 40, or 45%, had symptoms.

2. *Spontaneous Nystagmus.* It was common to observe a fine nystagmus on lateral gaze. This usually occurred in those patients with subjective symptoms, and objective evidence of depression of the labyrinth. A report on the exact number with this symptom cannot be given. The nystagmus was often rather intangible and transitory, and was evaluated differently by the different observers. Some felt that it was physiological.

3. *Hearing.* None of the patients in the study group noted any loss of hearing. A comparison of audiograms made before, dur-

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ing and after treatment did not reveal any significant change. Included were those with a severe loss of hearing in one ear, older patients with high tone loss, and some with a dip at 4096 d.v., commonly seen in servicemen exposed to gunfire. One patient, not in the study group, received the 2-gm. dose for three weeks. He was a paraplegic, in coma and critically ill with a kidney infection. No pretreatment ear examination was performed. His general condition improved markedly, but suddenly, on the twenty-first day, he was noted to be profoundly deaf. When seen the next day there were no caloric responses, and he could not hear the shouted voice or any of the forks. The audiogram revealed an average loss of 80 decibels. This loss of cochlear and vestibular function has persisted. He had an anuria, and undoubtedly a very high blood concentration of streptomycin.

4. *Caloric Tests.* Depending on the duration and character of the after-nystagmus, the results of caloric tests were classified as normal, slight, moderate or marked depression, or absent responses. A gradual diminution was not always seen. The result could be normal at one visit but on repeating the tests two or three weeks later no response would be obtained. No case with complete loss of function was found to improve. Of the 53 patients in Group I, there were 21 with absent caloric responses after completing treatment. One patient had absent responses in only one ear. Two had slight and one moderate depression of function. This makes 25 out of 53, or 47%, in Group I with objective evidence of vestibular damage.

Of 40 patients in Group II, those receiving 1 gm. per day, only six had absent responses at the end of their course of the drug. Three had slight, three moderate and one marked vestibular depression. Thus 13 of 40, or 32.5%, of the patients on the 1 gm.-dosage had objective evidence of vestibular damage.

There was close correlation between subjective symptoms and objective findings. While not all who complained of dizziness and staggering had evidence of damage, the opposite was true. The patients found to have depressed or absent caloric responses had complained of symptoms during treatment.

The patients who had no caloric reaction had a characteristic walk. The feet were wide apart; the gait seemed studied. When blindfolded they had great difficulty walking on irregular surfaces, tending to weave and even fall.

DISCUSSION

Other observers ^{3, 4, 5} have reported a higher percentage of objective evidence of vestibular damage than found in this study. An all or none effect was noted in these patients; the vestibular responses were entirely absent or normal. It is admitted this may be due to the less delicate method of testing. The method of using hot and cold stimuli to determine directional preponderance, proposed by Fitzgerald and Hallpike⁶ and used by Fowler,⁵ may be more sensitive. It was felt to be too involved for this study where the personnel performing the tests frequently changed.

According to Jones⁷ it would seem that the vestibular tests could be used to diagnose and accurately localize cerebral lesions. This opinion has changed with the years until recently the caloric tests have been used more to determine the presence or absence of response in the labyrinth. The number of patients who have vestibular symptoms after streptomycin therapy may stimulate interest in a precise method which will localize the site of the damage. Even using the directional-preponderance method Fowler was not able to determine whether the site was central or peripheral. The results of this study do not help in localization, unless it can be argued that a process so commonly involving vestibular and not cochlear function is central rather than peripheral. A more precise method than the tilt table method of testing the static labyrinth, the maculae of the saccule and utricle, would be of value.

No standard method of recording vestibular tests exists. A graph similar to an audiogram would seem to be most desirable. Fitzgerald and Hallpike⁶ have such a record, called a calorigram. It is based entirely on the duration of the after-nystagmus measured from the beginning of the stimulus. It does not take into account the quality, speed, vigor and amplitude of the eye movements. It is not easy to determine the end point exactly in streptomycin cases, especially those with the fine spontaneous nystagmus.

The question may well be raised as to the value of vestibular tests in streptomycin therapy. Chances of hearing loss are so remote that frequent audiograms do not seem necessary. The caloric tests are not a guide to therapy in these cases, the patients being ill with a serious disease, and treatment was completed in spite of evidence of loss of labyrinthine function. The tests have had the value of demonstrating the percentage with loss of function with the different

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dosages. The problem may well be solved by the new low dosage of 0.5 gm. if it proves as effective against tuberculosis.

It is not the scope of this report to evaluate the effect of the drug in tuberculosis. However, it is difficult to refrain from mentioning the amazing improvement seen in patients with severe tuberculous laryngitis. Tuberculous otitis media has also responded promptly after local measures had been used with little result.

The difficulties confronting the patients may increase after they leave the hospital. It will have to be determined whether they can drive a car, climb stairs, board street cars, and carry on their previous occupations. There may also be medicolegal implications.

SUMMARY

This is a report of the results of ear examinations done on 93 patients receiving streptomycin at Hines Hospital. They are divided into two groups according to dosage. Group I received 2 gm. per 24 hours for four months. Group II received 1 gm. per day. Audiograms and caloric tests were done before, during and after treatment.

One patient with an anuria suffered almost total loss of hearing, but no other patient was found to have any hearing loss from the drug.

Of the 53 patients in Group I, 42 noticed subjective symptoms of dizziness, staggering gait or visual disturbances, and 25 had objective evidence of depressed or absent vestibular function. Of the 40 in Group II, 18 complained of subjective symptoms, and 13 had depressed or absent caloric responses. No return of function was noted later in those without response. They also continued to have subjective complaints, trouble in walking in the dark and dizziness, although these symptoms diminished. These patients were grateful for the improvement in their general condition and did not seem to feel the vestibular disturbances were too high a price to pay for it.

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AMYLOID TUMORS OF THE LARYNX, TRACHEA
OR BRONCHI

A REPORT OF 15 CASES

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The larynx and trachea are the most common sites of localized deposition of amyloid. Although of infrequent occurrence, the disease may present definite diagnostic and therapeutic problems. A clinical and pathologic review of 15 cases of tumor-forming amyloid disease of the larynx, trachea or bronchi forms the basis for this paper.

In 1853 Virchow¹ observed that the substance present in organs which were the seats of so-called lardaceous or waxy change reacted with iodine to form a characteristic yellowish-red or reddish-violet color. This changed to a perfectly blue or violet color when the application of iodine was followed by the very cautious addition of sulfuric acid. This reaction being similar to, but not the same as, the reaction of starch with iodine, Virchow considered the "waxy" substance to be starch-like, or "amyloid", and probably a form of animal cellulose.

The chemical composition²⁻⁵ of this amyloid has not been exactly determined. It would appear to be somewhat inconstant, consisting of one or more protein fractions and a sulfur-containing polysaccharide similar, at least, to chondroitin-sulfuric acid.

STAINING PROPERTIES OF AMYLOID

The distinctive reaction of amyloid with iodine, and iodine and sulfuric acid in the gross, demonstrated by Virchow, distinguished this material from other hyaline materials. Jürgens, Heschl and

Abridgment of thesis submitted by Dr. Stark to the Faculty of the Graduate School of the University of Minnesota in partial fulfillment of the requirements for the degree of Master of Science in Surgery.

Cornil⁶ introduced the use of methyl violet as a stain to aid in the more nearly accurate observation of histologic details.⁷ Subsequently, Congo red was introduced as a dye with a special affinity for amyloid, to be used in the staining of microscopic sections, and, as in Benhold's test, to be used in the clinical determination of the presence of amyloid in the living person⁸.

CLASSIFICATION OF AMYLOID DISEASE

To simplify the rather confusing terminology used to distinguish the various forms of amyloid disease, Reimann, Koucky and Eklund⁹ suggested a simple clinicopathologic classification of amyloid disease: (1) primary amyloidosis, (2) secondary amyloidosis, (3) tumor-forming amyloidosis, and (4) amyloidosis associated with multiple myelomas.

The amplification of this classification by these authors follows.

Primary Amyloidosis. The primary (by some called the "atypical" or "systematized") form of the disease is characterized by: (1) absence of preceding disease, (2) absence of involvement of organs or tissues usually affected in the secondary form of the disease, (3) involvement of the mesodermal tissue, cardiovascular system, gastro-intestinal tract and smooth and striated muscle, (4) a failure of the amyloid deposits to react in the ordinary manner to the accepted stains for amyloid, and (5) a tendency to nodular deposits of amyloid material.

Secondary Amyloidosis. The secondary (by some called the "typical," "classical" or "generalized") form of the disease usually follows a chronic wasting disease (such as chronic pulmonary tuberculosis, chronic empyema and chronic osteomyelitis). It is characterized by large deposits of amyloid material, especially in the spleen, liver, kidneys and suprarenal glands, and by the typical staining reactions of the deposits.

Tumor-forming Amyloidosis. Tumor-forming amyloidosis is characterized by the presence of small solitary or multiple tumors in the eyes, bladder, urethra, pharynx, tongue and especially in the respiratory tract.

Amyloidosis Associated with Multiple Myelomas. Amyloidosis occurring with multiple myelomas is secondary in nature, but the

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distribution and character of the deposits frequently resemble those of the primary form of the disease.

Even the foregoing classification is not entirely satisfactory because of the frequent overlapping of characteristics.

AMYLOID TUMOR OF THE LARYNX, TRACHEA OR BRONCHI:

PREVIOUS STUDIES

Burow and Neumann¹⁰ in 1875 apparently were the first to report a case of amyloid tumor of the larynx. A number of reports of amyloid tumor involving the larynx, trachea or bronchi have been published since that time. The pertinent literature has been reviewed by Pollak,^{11, 12} New,¹³ Schmidt,¹⁴ Kramer and Som,¹⁵ and Rey.¹⁶

Incidence. Nineteen cases of laryngeal amyloidosis have been reported in the American literature to date, by Hooper,¹⁷ Eisenbrey,¹⁸ New¹³ (4 cases), Thompson,¹⁹ Beavis²⁰ (5 cases), Kramer and Som,¹⁵ Pearson and associates,²¹ Figi,²² Clerf,²³ Seydell,²⁴ Jackson,²⁵ and Spain and Barrett.²⁶ Kramer and Som considered that of 95 cases of primary or "idiopathic" amyloid tumors of the upper part of the respiratory tract included in the literature up to 1935, 36 involved the larynx alone, 8 involved the larynx and tongue, 13 involved the trachea alone, and 4 involved the trachea and bronchi. Lesions involving the bronchi have been reported by Balser,²⁷ Glockner,²⁸ Werdt²⁹ and Falconer.³⁰

Classification. According to one of us (G. B. N.), amyloid tumors of the larynx, trachea or bronchi may be considered to occur either in association with amyloid degeneration elsewhere in the body, or as isolated deposits. The isolated deposits may be divided into three groups: (1) diffuse subepithelial infiltration by amyloid, (2) tumor-forming amyloid deposits, and (3) amyloid degeneration in a pre-existing tumor.

The cases of laryngeal amyloidosis reported by Pearson and associates, and Spain and Barrett are examples of laryngeal lesions associated with the deposition of amyloid elsewhere in the body. Since the laryngeal lesions are incidental to the more generalized disease, and since treatment and prognosis apply essentially to the generalized form of the disease, laryngeal amyloidosis associated with generalized amyloidosis will not be included in the subsequent discussion.

Causation. That amyloid tumors most often occur in organs consisting in part of cartilage and in which abnormal calcification or ossification is a frequent occurrence has been noted by many authors.³¹ The fact that calcification or even osteoid tissue occurs so often in amyloid tumors, and the presence of amyloid material in tumors considered to be primarily the results of exostosis or ecchondrosis²⁸ are suggestive evidence that some factor is common to the formation of amyloid material, osteoid tissue and local calcification. Chronic inflammation has been considered a causative factor. The association of conjunctival amyloidosis with trachoma would seem to support this conjecture. Amyloid tumors have been described in syphilitic scars,³² and in some reports the importance of chronic recurrent infection of the upper air passages prior to formation of the amyloid tumor has been emphasized.¹⁶ However, in many reports this pre-existent chronic inflammation is not disclosed. Amyloid degeneration of pre-existing tumors has been described.^{33, 34} The association of amyloid material with a squamous-cell epithelioma as described by Beavis (case 2) would seem to be coincidental, although a closer relationship might be suggested. It is noticeable that a great number of amyloid tumors have no apparent associated pathologic process which might be considered of causative importance.

Sex. The lesion occurs more frequently in men in about the ratio of 3 men to 1 woman.¹³⁻¹⁵

Age. The majority of patients are between the ages of 50 and 70 years at the time the diagnosis of amyloid tumor is made. In the literature, the youngest patient was 19 years old²³ and the oldest patient was 80 years old³⁵ at the time of diagnosis.

Symptoms. When symptoms are present, they are caused by the physical presence, size and location of the tumor. Usually, they are hoarseness and dyspnea. Willimann³⁶ reported a case in which the diagnosis was made six weeks after the onset of symptoms. Thompson¹⁹ described a woman 32 years old whose chief symptom of hoarseness had been present at least twenty-five years before the diagnosis of deposition of amyloid was made. The usual duration of symptoms before diagnosis has been between one year and two years.

Gross Aspects of the Tumor. The typical gross appearance of the amyloid tumor has been said to be a waxy, translucent, yellow or yellow-gray swelling without ulceration of the overlying mucosa. The lesion has been reported to have either a smooth or a nodular out-

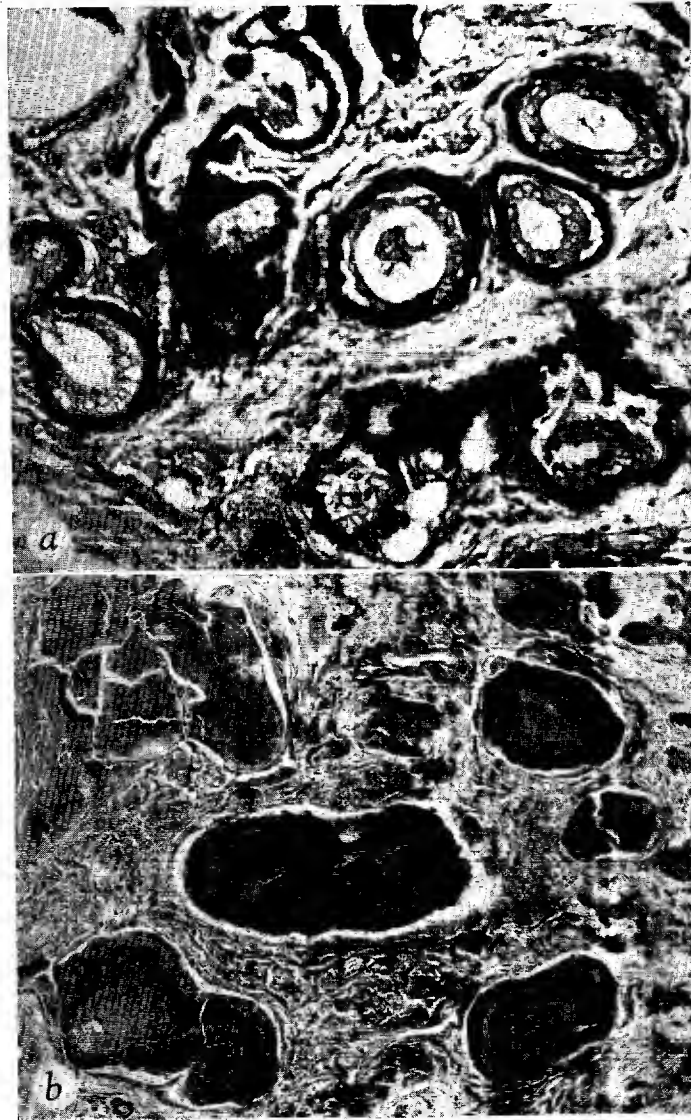


Fig. 1.—Photomicrographs showing: *a*, amyloid material deposited along the basement membrane of mucous glands (x200); *b*, concentric ringed masses: the well-demarcated lines are very evident (x250). Both sections stained with crystal violet.



Fig. 2.—*a*, Lateral roentgenogram of the larynx in case 15, demonstrating a retrotracheal soft-tissue mass causing significant narrowing of the airway; note the areas of calcification; *b*, tomogram of the larynx in the same case as in *a*, demonstrating some thickening of the true cords, and a tumor mass in the subglottic region on both sides.

line, and to be either diffuse or well localized. The tissue has been described as being either hard on palpation and difficult to curet because of this consistency,³⁷ or friable and vascular, in which case the color has been red.

Microscopic Appearance. There is no difference between the microscopic appearance of the diffuse lesion and that of the tumor-forming type of lesion.¹⁶ Subepithelial deposition of the homogeneous hyaline amyloid material occurs. The mucosa and submucosa are elevated by the amyloid deposit, which is seen in layers closely packed between the connective tissue. The walls of the blood vessels are especially affected.¹³ Beavis noted that the rounded masses present in many amyloid tumors appeared to arise in the blood vessels. Many authors noticed that the basement membrane of the mucous glands was swollen by the homogeneous amyloid³¹ (Fig. 1*a*). Courvoisier³⁸ described a lesion in which this involvement had progressed to such extent that the glands had been replaced by masses of amyloid material (Fig. 1*b*). Giant cells have been considered by some to be typical of the lesion.¹⁶

As a rule, the amyloid material is stained selectively by Congo red and iodine, and it is stained metachromatically with crystal violet

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and other related aniline dyes. Beavis and others have described lesions in which apparently only the oldest portions of the deposit stained as amyloid, the reaction in the remainder being nondescript. Many authors consider that these specific color reactions may be weak³⁹ or not present at all.^{40, 41}

Diagnosis. The diagnosis of an amyloid tumor is made by microscopic examination of sections of tissue from the lesion. The extent of the lesion may be determined visually by laryngeal examination, roentgenologic examination (Figs. 2a and b), tracheoscopy or bronchoscopy.^{22, 37} Evaluation of the extent of a recurrent lesion or a lesion of which the diagnosis has been established may be simplified by staining of the amyloid by the intravenous injection of Congo red.¹⁵

Treatment. Occasionally, tracheotomy has been necessary to relieve the obstruction brought about by the amyloid tumor in the larynx or trachea. Excision of the lesion, when feasible, has been considered the treatment of choice.¹⁵ Partial excision, when total excision is not possible, to be followed by irradiation, has been suggested.¹³ Mutschler⁴² used a diathermy loop for removal of the tumor in an effort to avoid scarring. Willimann⁴³ and Simonetta⁴⁴ advised roentgen therapy. Kriegsmann⁴⁵ recommended the production of local hyperemia by the use of short waves. Bauer⁴⁶ in 1932 suggested that extirpation of a subglottic or tracheal lesion followed by use of a dermal graft over the denuded area might be feasible. Figi in 1942 described how he had removed an extensive subglottic lesion and grafted the resulting bare area with a split-thickness graft. This prevented the extensive scarring which would have resulted if the denuded area had been left uncovered.

Results of Treatment. The value of irradiation therapy has not been definitely determined. Bauer considered such therapy to be ineffective. Repeated recurrences have been reported by many authors after attempted removal of the lesion. Pollak^{11, 12} and Greifenstein⁴⁷ described cases in which the lesion regressed after incomplete removal. Rey considered the prognosis of untreated amyloid tumor to be good. He said that malignant degeneration did not occur. There was reported to be some danger of respiratory obstruction, dependent on the size and location of the deposits. The prognosis, then, was considered to be that associated with any benign tumor of the same size and in the same location. It was considered to be bad if the lesion was located in the lower part of the respiratory tract.

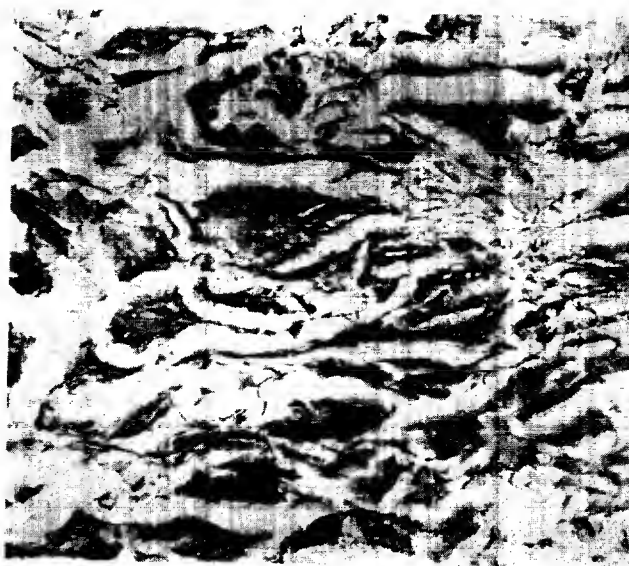


Fig. 3.—Photomicrograph showing sharply outlined well-demarcated flakes of amyloid material. (Hematoxylin and eosin; x100).

NATURE OF THE PRESENT STUDY

Records of 28 cases in which the diagnosis was amyloid degeneration of the larynx, trachea or bronchi were found in the surgical files of the Mayo Clinic. In all the cases the diagnosis of amyloid disease had been made by microscopic examination of tissue removed for biopsy or at operation. In the vast majority of instances the diagnosis had been made on the basis of the appearance of the frozen section stained with hematoxylin and eosin. Adequate amounts of tissue for further study with special stains were available in 24 cases. In three cases, only slides of sections stained with hematoxylin and eosin were available. In one case (case 2 in a previous clinic series¹³) neither slide nor tissue was available.

A detailed study of the histopathologic aspects and staining reactions of the available material has been undertaken.⁴⁸

Briefly, the pathologic features considered characteristic of the tumors were: (1) The homogeneous amyloid material occurred mainly in the form of "flakes" (Fig. 3) or "concentric-layered masses" (Fig. 1*b*), and (2) this amyloid material reacted character-

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istically with one or more of the so-called amyloid stains. The diagnosis of amyloid degeneration was confirmed by this study in 15 of the 28 cases reviewed. Records of the 15 patients who had amyloid lesions form the basis for the subsequent material (see table).

CLINICAL OBSERVATIONS

Sex. There were 10 men and 5 women, a ratio of 2:1.

Age. The age of patients at the time of examination varied moderately. The youngest patient was 36 years old; the oldest was 69 years; the average age was 55 years (see table).

Location of Lesion. In seven instances the lesion involved the larynx at or above the vocal cords. In four instances only the subglottic region was involved. In one instance the vocal cords and subglottic region, and in two instances the subglottic region and the trachea, were involved. In only one instance was bronchial involvement demonstrated. The larynx also was involved in this case.

Symptoms. The duration of symptoms varied from five months to seven years, the average duration being about eighteen months. Hoarseness was the presenting complaint in 11 cases. Three of these patients complained also of dyspnea. Dyspnea was the presenting complaint in two instances, and hoarseness was an associated symptom in both of these. Cough was the presenting complaint in only one instance. One patient had no complaints referable to the respiratory tract.

Appearance of Lesions. Four of the lesions were sufficiently well circumscribed to be considered local tumors. The remainder of the lesions were less well localized and might be described as "diffuse submucosal thickenings." The lesion usually was smooth in outline, although in two instances (cases 1 and 15) irregularities were noted. In ten cases the color was not remarkable enough to cause comment. Yellow areas were noted on three occasions. One lesion was described as gray throughout, and one lesion was described as being red. The mucosa overlying the lesion was uniformly healthy.

Diagnosis. Preoperatively, four of the lesions were considered to be malignant. The remaining 11 lesions were considered preoperatively to be benign. A diagnosis of "amyloid tumor" was considered in three of these cases. A definite diagnosis was made only by microscopic examination of tissue from the lesion.

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TABLE
CLINICAL AND PATHOLOGIC DATA IN 15 CASES OF AMYLOID DEGENERATION
IN WHICH DIAGNOSIS WAS CONFIRMED

Patient	Age at time of diag- nosis	Sex	Symptoms, duration	Lesion				Treatment				Results		Follow- up (Time after diag- nosis, years)	Remarks
				Glottis	Subglottis	Trachea	Bronchi	Type	Excision	Graft	Radiation	Hoarseness	Dyspnea		
1	56	F	1 yr. 7 mo.		+	+		Diffuse	+	+	+	+	+	31	New's case 1. ¹³ Permanent tracheostoma.
2	52	F	5 mo.	+				Diffuse	+	+	+	0	0	29	New's case 4. ¹³
3	36	F	7 yr. 1 mo.	+				Sessile tumor	+	+	+	+	0	29	New's case 3. ¹³
4	69	M	2 yr.	+				Diffuse		+	+	+		13	Some improvement; only temporary after irradiation.
5	58	M	3 yr. 3 mo.	+	+			Diffuse	+			0	+	18	Permanent tracheostoma.
6	67	M	10 mo.	+				Tumor	+			0	0	1	
7	51	F	8 mo. 8 mo.		+			Diffuse		+	+	0	0	2	Temporary tracheostoma because of diminished airway. Apparently good result with irradiation alone.

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8	49	M	2 yr.	+	Diffuse			+	+	0	6	
9	39	M	5 yr.	+	Diffuse			+	+		6	
10	66	M	8 16 mo. mo.	+	Diffuse		+	+	+	0	6	Fig's case. ²² Temporary tracheostoma during grafting procedure.
11	40	M	18 mo.	+	Diffuse		+	+	+	0	6	
12	63	M	1 yr.	+	Tumor		+	+	0	0	2	
13	68	M	6 mo.	+	Diffuse	+	+	+	+	0	2	Bedridden after stroke. Died of terminal pneumonia.
14	67	M	0 0 0	+	Tumor		+	+	0	0	2	Lesion noted on epiglottis at routine laryngeal examination.
15	42	F	6 6 mo. mo.	+	Diffuse		+	+	+	0		Temporary tracheostoma during grafting procedure.

+ indicates persistence of symptom.

0 indicates absence of symptom at time of follow-up.

Causation. In no instance was there a general debilitating disease of the type which might be considered as predisposing to the secondary form of amyloidosis. The only observation considered significant was the general age group to which these patients belonged: the age group in which degenerative processes of many kinds do occur.

REPORT OF CASES

CASE 5.—A man 58 years old was examined at the clinic in January, 1929. He complained of progressive hoarseness and dyspnea of three years' duration. Indirect laryngeal examination disclosed a marked thickening in the region of the posterior two-thirds portions of both vocal cords, more marked on the right side, and fullness in the subglottic region. Although there was considerable limitation of the airway in the subglottic region, the vocal cords moved freely. The mucosa overlying the thickening appeared to be healthy. The lesion was considered to be an epithelioma.

Results of a roentgenogram of the thorax, blood count, flocculation test and urinalysis were normal. General examination disclosed some degree of emphysema and chronic bronchitis.

A diagnosis of amyloid degeneration was made by biopsy of a specimen of the laryngeal lesion. Tracheotomy was performed because of the limited airway. The lesion was cauterized on two occasions. In answer to a letter of inquiry in February, 1947, eighteen years after the time of diagnosis, the patient wrote that he had continued to wear the tracheotomy tube because without it he would become dyspneic on exertion. He considered his voice to be normal. He had had no additional treatment, and believed that the laryngeal condition was not progressing.

Comment on Case 5. This case demonstrates that the occurrence of an amyloid tumor is not incompatible with long life. No disease which might have contributed to the deposition of the amyloid became evident over the years. The self-limiting nature of the disease in this case is indicated by the fact that although enough of the tumor remained to obstruct the airway, the lesion did not progress to involve the vocal cords to a degree sufficient to produce more hoarseness.

The tumor in this instance was mainly subglottic in distribution, and the vocal cords moved freely. We believe that wide excision of the lesion followed by grafting the denuded area with split-

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Fig. 4.—Roentgenogram of the thorax in case 13, showing a hilar mass on the left, with a suggestion of bronchial obstruction.

thickness skin would have provided this patient with an adequate airway and would have eliminated the necessity for a permanent tracheostoma.

CASE 12.—A man 63 years old was examined at the clinic in July, 1942. He complained of progressive hoarseness of a year's duration. Indirect laryngeal examination disclosed a tumor 1 cm. in diameter on the anterior half of the left false cord.

Results of a roentgenogram of the thorax and of a flocculation test were negative. Urinalysis demonstrated albuminuria of grade 1+. General examination disclosed an obese man with dental caries.

A diagnosis of amyloid degeneration was made on the basis of biopsy of a section of the laryngeal lesion. The tumor was removed with biting forceps, and the base was destroyed with electrocautery. In answer to a letter of inquiry this patient's physician stated that in 1944, when the patient was last examined, there was no hoarseness or evidence of laryngeal obstruction.

Comment on Case 12. The excellent functional result to be expected after excision of a localized tumor is demonstrated by this case.

CASE 13.—A man 68 years old was re-examined at the clinic in September, 1943. He complained of an intractable, nonproductive cough of six months' duration. This cough persisted after a febrile illness which was considered to be an atypical form of pneumonia. The cough was most annoying when the patient was up and around, and abated when he was lying down. Indirect laryngeal examination disclosed a fullness of the anterior part of the right false cord, causing it to overhang so that the right true cord was not visible.

A roentgenogram of the thorax (Fig. 4) disclosed a hilar mass on the left. The possibility of bronchial obstruction was suggested. Urinalysis demonstrated albuminuria of grade 2+ and pyuria. Result of a flocculation test was negative. General examination disclosed that a neurofibroma had been removed from the spinal cord in 1931, with resultant "cord bladder." No other abnormalities were noted. A roentgenogram of the thorax made in 1931 had been reported as disclosing nothing remarkable.

On bronchoscopic examination, the right side of the larynx appeared to be fixed by an infiltrating lesion. When the bronchoscope was introduced into the left main bronchus, the medial wall was noted to be pushed laterally. It was infiltrated and had the gross appearance of carcinoma. A diagnosis of amyloid degeneration was made by biopsy of a section of this lesion.

The patient was treated postoperatively with roentgen rays directed to the left hilar region, and the cough was controlled by a sedative cough mixture. A roentgenogram of the thorax made one year after this treatment was reported to show no change in the pulmonary fields. In answer to a letter of inquiry, the patient's physician stated that the patient had had no more difficulty with his thoracic lesion. In April, 1945, eighteen months after the diagnosis, the patient had a cerebral hemorrhage, with residual paralysis and mental changes. In August, 1945, terminal pneumonia developed and the patient died.

Comment on Case 13. Endobronchial amyloid tumors have been reported infrequently; the lesions have been observed at post-mortem examination. This case is reported as an instance of a

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diffuse amyloid tumor involving the bronchial tree (and larynx) diagnosed during the life of the patient. Postmortem examination was not performed in this instance, and we have no proof that amyloid was absent in other organs of the body. Conversely, there is no evidence to suggest that such depositions did exist. It does not seem probable that the cerebrovascular accident in 1945 was at all related to the amyloid disease.

The treatment of this type of lesion is difficult and unsatisfactory. Endobronchial removal of amyloid material by instrumentation or the use of roentgen therapy to the involved region is the most obvious form of therapy. Should the lesion be localized to one bronchus, and should other treatment prove inadequate so that symptoms secondary to bronchial obstruction become prominent, lobectomy or pneumonectomy should be considered.

COMMENT

Although there is not universal agreement as to the best form of treatment of amyloid tumors situated in the respiratory tract, certain general principles are apparent.

The form of treatment and the prognosis as to functional recovery after treatment will depend on the type of amyloid involvement (whether the lesion is a localized tumor or a more diffuse subepithelial infiltration) and the location of the amyloid involvement.

The well-localized tumor, no matter what its location, should be removed surgically. A diffuse infiltrating lesion involving the subglottic region and the trachea is best treated by surgical removal of as much of the lesion as is possible, and by covering the resulting denuded area with a split-thickness skin graft in the manner reported by Figi. In such cases the functional results can be expected to be good.

Treatment of the diffuse infiltrating lesion involving the larynx proper has not produced as gratifying results. Attempts at extensive removal of the lesion have brought about deformities which themselves have prevented a satisfactory functional result. Extensive removal of the lesion with successful application of a skin graft to the denuded area should exclude the necessity for a permanent tracheostoma, but permanent hoarseness would be inevitable. Although the true status of irradiation therapy in this disease has not been established to the satisfaction of all, there have been enough

favorable reports to warrant employment of such therapy in those cases in which complete surgical removal of the lesion is not feasible (case 7).

The observation that patients live many years with evidence of the presence of the intralaryngeal tumor without progression of symptoms to the point at which tracheotomy is required to provide an adequate airway, is good evidence that the disease tends to be self-limiting. In no instance in this series could the death of a patient be ascribed to the amyloid tumor.

SUMMARY

The clinical features of 15 cases in which the pathologic diagnosis was amyloid tumor of the larynx, trachea or bronchi have been reviewed. The pathologic features considered characteristic of the tumors are occurrence of the homogeneous amyloid material mainly in the form of flakes or concentric-layered masses, and a characteristic reaction of the amyloid material with one or more of the so-called amyloid stains. No concomitant disease considered of etiologic significance was noted. The presenting signs and symptoms of amyloid tumor are dependent on the size and location of the lesion. Classification of the tumors into the localized tumor-forming variety and the diffuse infiltrating variety is of significance in determination of the type of treatment to be employed and the prognosis after treatment. The localized tumor was surgically removed, with an excellent functional result. The diffuse lesion involving the subglottic region and the upper part of the trachea was removed with immediate grafting of the resultant denuded area. A permanent tracheostoma was avoided, and the functional results were excellent. The functional results obtained by treatment of the diffuse lesion involving the glottis proper were not as satisfactory. The prognosis as to life was excellent, with the possible exception of those patients who had endobronchial lesions. The disease tended to be self-limiting.

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In 1941 he reported 40 cases of cartilage transplant, chiefly for the correction of loss of nasal bridge support, and 115 cases of iliac bone transplants of which 102 cases were transplants to the nasal bridge.

The cartilage transplants proved unsatisfactory because 25% of them became severely distorted.

Mowlem stated that the first case of iliac bone transplantation to restore the nasal bridge recorded in Great Britain was carried out in 1932 by Gillies. The donor area was the iliac crest. The cases reported by Mowlem were operated upon between 1935 and 1941.

His operative procedure is described as follows:

"The iliac crest is exposed, the attachments of the abdominal muscles and gluteal muscles are cleared by blunt dissection. The dense outer lip of the iliac crest is removed. The requisite piece of *cancellous* bone may consist of either part or whole of the blade of the ilium. Shaping is carried out by sharp cutting instruments and during this process as much of the cortical bone as possible is eliminated. In other words, the transplant is designed to consist chiefly of cancellous tissues and to contain the minimal number of traumatized cells."

The grafts were inserted into the nose by splitting the columella and separating the two layers of the septum as far up as the lower margin of the remnants of the nasal bones. The periosteum over the remnants was raised to enable the transplant to lie in close contact with these bones.

In 66 of his 102 cases, bony union was obtained with the underlying bones. There was no clinical or radiographic difference between those grafts which became adherent and those which remained unattached.

He further noted on x-ray study that irregularities in contour became rounded off in about two months and the graft decreased slightly in size. The peripheral cancellous bone became replaced by an apparently normal cortical structure. There was no phase of rarefaction. One graft superimposed upon another might easily acquire bony union with it.

Malbec⁸ employed autogenous, homogenous and heterogenous cortical bone grafts in rhinoplastic procedures. His subsequent x-ray studies and observations proved that autotransplants adapted themselves best of all.

XI

CANCELLOUS BONE GRAFTS IN NASAL REPAIR

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The use of cancellous bone obtained from the crest of the ilium is gaining widespread recognition for its value in the correction of saddle-noses. Fomon and his collaborators¹ have stimulated a great interest in this subject and have inspired many surgeons to use this material not only for the correction of saddle-nose but also for other deformities about the face and forehead. Cancellous bone is readily available and its consistency permits easy modeling. It resists infection and absorption, is well tolerated by the tissues and is not subject to change in shape. These qualities make it most desirable for building up depressions of the nose. Fomon compared cancellous bone with all other materials that have been used in grafts and pointed out the advantages of the former over white vaseline, ivory, celluloid, gold, platinum, silver, aluminum, amber, triconium, plexiglas, vitallium, acrylic resins, tantalum, and the soft tissue implants such as periosteum, muscle, fascia, derma grafts and catgut.

The advantages of cancellous bone over the use of cartilage, either isogenous or autogenous, were demonstrated by Mowlem.²

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MacCollum⁴, writing on the correction of old nasal fractures, discussed preparation of the nose for the reception of bone grafts as follows:

"These old fractures are characterized by a flattening of the entire nasal bridge in addition to a crushed and badly deviated septum which is not able to be permanently raised or straightened. It is preferable to perform a submucous resection of the distorted septum and possibly during the same operative procedure to refracture and set the nasal bones into as nearly normal a position as possible. After a six month interval, further elevation of the bridge-line can be accomplished by the insertion of the graft."

MacCollum employed cortical bone as grafting material.

Barsky⁵, in discussing bone grafts, emphasized the use of molded bone grafts but made a point not to advocate these for use in the nose, because "any minute irregularity would be too obvious." However, he reported the successful use of iliac grafts consisting of shavings of dense bone and spongy bone molded into shape for the restoration of facial contours.

In the healing of grafts cancellous bone is of greater usefulness than cortical bone and in the article of Abbott⁶, who in his summary gives the following conclusions, we find perhaps the best reason for this fact. He states:

"We should emphasize that the mature elements of either cortical or cancellous bone grafts seldom survive transplantation. Those elements which may survive and produce new bone are the cells of so-called endosteal and periosteal layers. A cortical graft is a solid mass of mature elements with its surface covered by endosteum and periosteum. Therefore, it possesses strength but has little osteogenetic power. On the contrary, cancellous bone has a loose pattern with interlacing and branching trabeculae, every one of which is covered with endosteal cells. It possesses a high osteogenetic power. Furthermore, this very loose structure permits of early and thorough revascularization. Cortical bone as a grafting material is most useful where strength is of primary importance, as in the ununited fractures of the shafts of long bones. It may be used to advantage with cancellous bone which furnishes the osteogenetic medium. Cancellous bone as a grafting substance is preferable in the treatment of ununited fractures of the ends of long bones and defects of bone caused by tumors or infection, for fusion of joints, fusion of the spine, and in correction of severe deformities by the open wedge type of osteotomy."

As to the mechanics of the healing of these bone grafts, Blocker⁷ from his own experience and from the writings of Gormley,^{8,9} Murray,^{10,11} Erich and Austin,^{12,13} and Fry¹⁴ states that:

"We know from experimentation and from experience that healing following transplantation of bone occurs in much the same fashion as after primary fracture. Organization of a clot occurs in the graft bed and there is invasion by

organizing vascular connective tissue at a rate which is in inverse proportion to the density of the graft."

Our own studies definitely corroborate the value of the use of iliac bone as an ideal graft material for the correction of nasal deformities.

Preparing the Bed.—To approach the dorsum of the nose an incision is made just at the caudal border of the lower lateral cartilage. By undermining with scissors and knives, the skin over the "dorsum" of the nose is separated from the bone and cartilage. This incision may be part of a typical rhinoplasty or a remodeling of the lobule, or it may be done alone or together with a similar incision on the other side. These incisions may be combined with the intercartilaginous incisions usually used in the start of a typical rhinoplasty. Just making a bed in this fashion is, in our opinion, not quite adequate. We believe that the bed must be so prepared that the bone graft comes into actual contact with freshly cut bone, the nasal bones or the superior maxillae. We have seen many times that the bone graft, although clinically satisfactory is, nevertheless, not fixed. This is due to the fact that the bone graft has had no opportunity to come in contact with freshly cut bone in the bed because the bones of the nasal bridge are covered with connective tissue, and unless this is removed vigorously and the nasal bones cut through or sawed off the bony graft will not grow to the underlying bone. Also, there may be present from a previous operation a graft of cartilage which will not become firmly adherent to any other substance, including bone. It is therefore our practice to chisel through the nasal bones or, if feasible, saw off a part of the bones of the nasal bridge which will smooth off and make a better bed in the first place, and secondly will provide good fresh cut bone to serve as the union area for the new bone graft.

To estimate the size and shape of the graft, Fomon recommended making a Stent model of the graft from a mask made from the patient's nose and face. This gives a rough idea of the size and shape of the piece of bone that needs to be replaced providing no surgery of the nasal bridge is done. When the bed has been surgically changed we use a large piece of isogenous cartilage cut to the size and shape that is thought will fit the best. This can be modeled, taken out and remodeled and the best possible fit made. The cartilage is then removed and used as a sample for size and form in taking out the bone graft. The chief difficulty is to estimate the contour of

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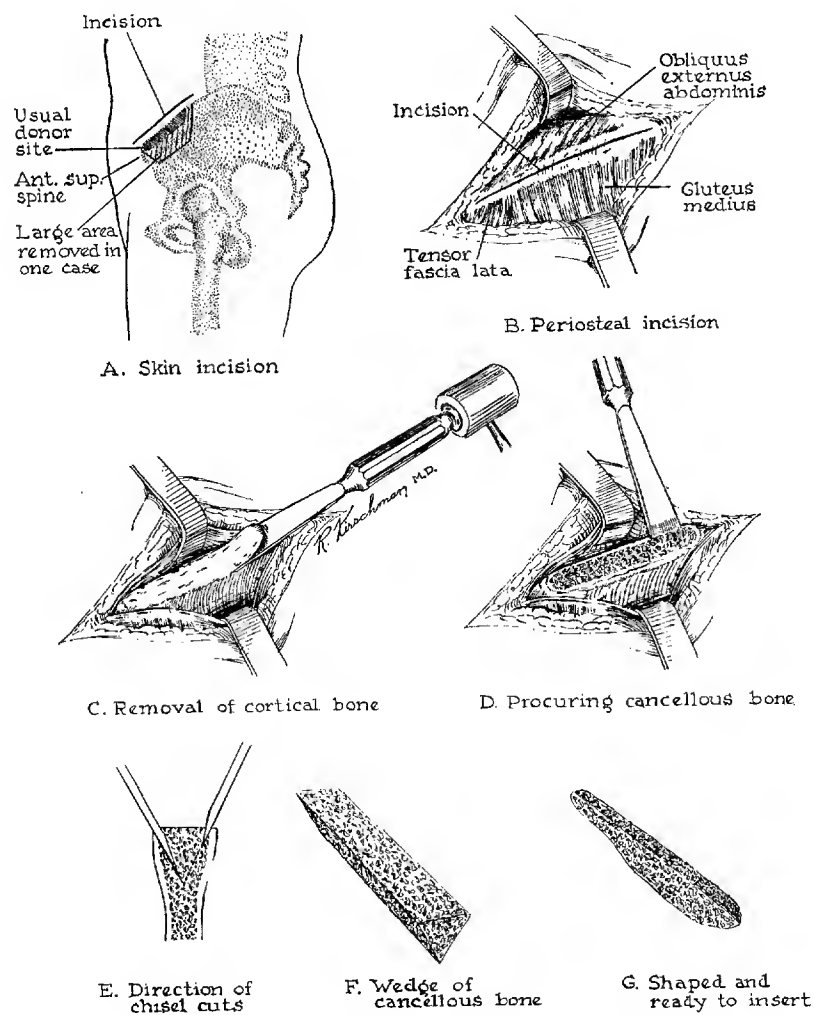


Fig. 1.

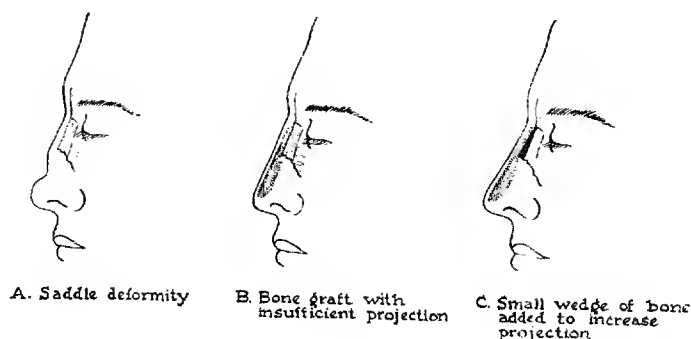


Fig. 2.

the floor of the bed. For this, soft materials, such as wax or moist cotton wound on an applicator, can be pressed onto the floor and after a moment or two removed, and the impressions made on the wax or moist cotton can be a guide as to how the base of the graft should be trimmed in order to fit most snugly into the bed.

Before removing the iliac bone from the donor area it is of technical advantage to shave off as much of the cortical bone as possible. A piece of cancellous bone is removed large enough to permit extensive modeling and to provide material for the use of buttons for the tip, columella battens or grafts and for supplementary grafts (Fig. 1).

If a graft is too small or so cut or trimmed that one feels a larger piece would be an advantage, a piece of cancellous bone in the form of a wedge the width of the base of the graft may be placed between the graft and the freshly trimmed nasal bones (Fig. 2 and 3), or a smaller graft may be placed onto the larger one (Fig. 4). Thus available material may be used to greater advantage and the need to go into the other hip for a new graft may be avoided.

Clinical Possibilities.—Bone may be grafted into the nose as a single operation or it may be done with additional nasal operations. Modeling of the lobule or total rhinoplasty may be done at the same time. All this may be supplemented with septum surgery. In other words we are of the opinion that an iliac bone graft may be used in addition to any external nasal surgery or septal surgery

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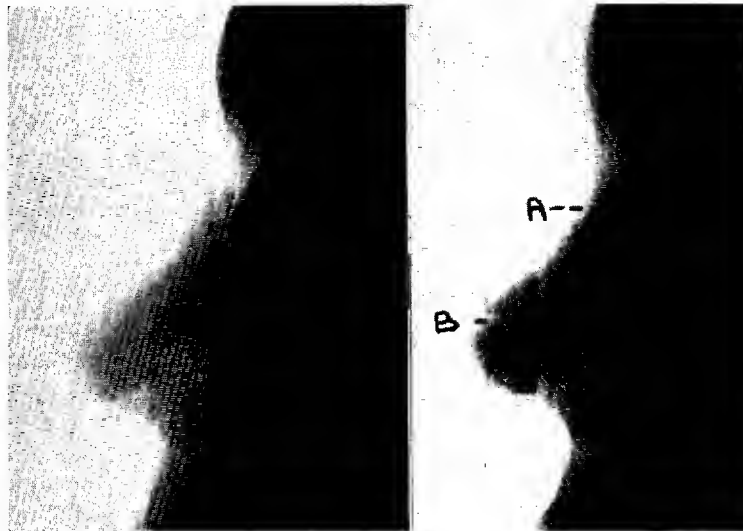


Fig. 3.—Small wedge of bone (A) placed under graft to increase projection. (Six months after operation.)

Fig. 4.—Smaller graft (A) put onto larger graft (B). (Two weeks after operation — no cortical bone present.)

that is necessary in a given case. The following case reports indicate the variety of these possibilities.

REPORT OF CASES

CASE 1.—A 45-year-old female with a large perforation of the septum gave a definite history of lues. In this case a slight cutting of the nasal bones with rasping was done after the skin was elevated through an incision in the right ala, caudal to the right alar cartilage. No surgery of the lobule was performed. Healing was prompt. Penicillin was given in large doses postoperatively.

CASE 2.—A 22-year-old male who had sustained an injury in early childhood had had two previous operations for the implantation of cartilage for the correction of saddle nose. At the operation one large piece of cartilage was removed, the second piece was left and a bone graft from the left hip was introduced. The

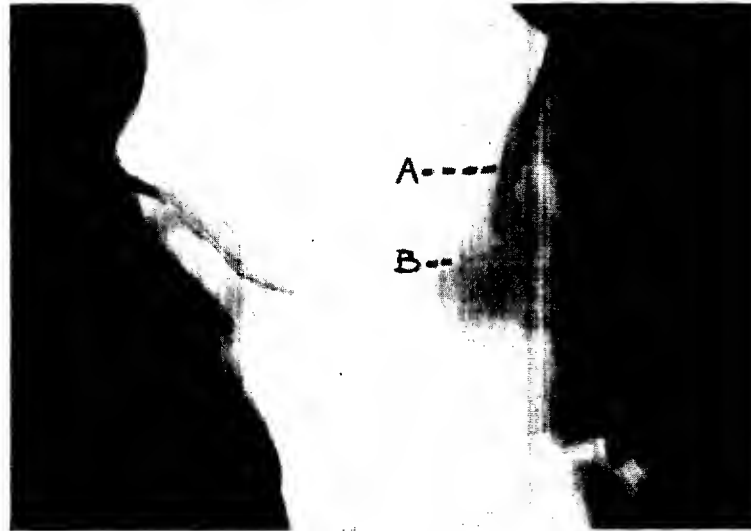


Fig. 5.—Graft grown onto ends of nasal bones. Note development of cortical thickening.

Fig. 6.—Graft considerably shrunken though firmly grown to nasal bones (A). Bone "button" in tip (B).

appearance and the retention of the bone graft is satisfactory but the bone graft is movable.

CASE 3—A girl aged 19 had sustained a crushing injury of the nose in childhood. The bed was prepared by separating skin over the nose from the underlying tissues via intercartilaginous incisions. The columella was corrected by the insertion of an isogenous cartilage batten; the lobule was modified by delivering the lower lateral cartilages, trimming them and modeling them to size. The alae were narrowed. A cancellous bone graft from the left hip was placed into the nose. The appearance two years later is adequate but the graft is not fixed but is movable on pressure.

CASE 4.—In a large man, aged 26, the bone-cartilage nasal pyramid was not proportionately developed. In this patient the bed was prepared and the lobule modified and corrected. The nasal bones were separated by chiselling and a very large bone graft was inserted onto them. This bone graft is fixed and seems to be an integral part of the nose itself. There has been no reaction or any

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discomfort. X-ray film reveals union with nasal bones and development of cortex (Fig. 5).

CASE 5.—A 34-year-old white female gave a history of a nasal injury 20 years ago with a persistent deformity. This was later aggravated by an injury when she was assaulted. This case illustrates a repair involving rhinoplasty and hip graft and partial septum surgery. The pyramid was uncovered and a transfixion was performed. A "hump" of about 7° was removed and considerable rasping of the dorsum was done. A columella pocket was made. The lower lateral cartilages were trimmed about 40%, the tips were bared, the medial crura were trimmed and sewed together with catgut sutures. The alae were freed, thinned and, after wedges were removed, narrowed. The caudal end of the septum was freed and moved to the right. The upper laterals were shortened about half an inch. A hip graft was inserted and two small pieces of bone were used as tip buttons. This graft has not become appreciably smaller and is not movable.

CASE 6.—A 37-year-old male had a marked nasal deformity and considerable difficulty of breathing. He had had many nasal injuries. This case represents another instance of the possibilities of performing many operative procedures in the nose at the same time: a total rhinoplasty, a total septal removal and reconstruction and a hip graft. The details of the procedure are given to emphasize how much was done. The pyramid was uncovered, encountering much scarring, a right hemitransfixion was performed with the resection of all the cartilage and bony septum. An autogenous cartilage strut was put into the columella. Chisel separation of the nasal bones and lateral osteotomies were performed with infracture and torsion of the bones. Packing was put into each nasal chamber and pieces of bone and cartilage were placed into the septum, according to a method previously described.¹² The lower lateral cartilages were trimmed about 20%, the medial crura were sewed together. Cancellous bone graft from the right iliac crest was placed on the "dorsum." The alae were narrowed. This patient had uneventful healing with a fixed graft and improved breathing.

CASE 7.—A 45-year-old white male gave a history of a nasal injury 20 years ago with a resulting marked deformity. A reconstruction was done about 1929 with a dorsal ivory implant and a columella strut, both of which were lost because of infection. Later other dorsal and columella implants were inserted, but these too were

lost, this time because of injury. There was a saddling of the cartilage vault and a cleft in the tip through which the previous operation was performed. The collapse of the alae, and pinching and scarring of the tip of the nose were marked. The caudal end of the septum was absent. The essential surgical procedures consisted of the shaving of the bony arch with a saw followed by chisel separation, the correction of the remainder of the nasal septum and the modeling of the lobule and tip. Lateral osteotomies, infracture and the insertion of autogenous cancellous bone graft of the dorsum and also a cancellous bone graft in the columella completed the operation. One year later the graft was fixed but had become considerably smaller, possibly because of the poor blood supply of the scarred tissues which made up the recipient area (Fig. 6).

CASE 8.—A 21-year-old male was involved in a very serious railroad accident with a marked deformity of the nose with scarring both inside and outside. The left nostril was completely occluded by scar tissue. The operation included partial correction of the septum, removal of scar tissue from the left nasal chamber and lining this raw area with a free skin graft. The bed was made via incisions caudal to the lower lateral cartilages through which the free cancellous bone graft was placed. After the bone graft was in position it was felt that the nasal arch was not high enough and a wedge of bone was placed between the nasal bones, which had previously been separated with a chisel, and the bone graft proper (Fig. 3).

CASE 9—A woman of 45 years of age was in an automobile accident and had a complete crushing injury of the nose. This was corrected at the time by the insertion of very thick pieces of isogenous cartilage in the form of an L. The columella strut was over one half inch thick and with great difficulty this material was removed. The septum was corrected and a chisel separation of the nasal bones performed. A cancellous bone graft was placed into the dorsum and into the columella. In spite of the marked scarring which had accompanied the presence of these enormous cartilaginous grafts, a firm nonmoving union occurred and the whole appearance of this individual was changed. With the cartilage grafts in place, the nose had an artificial, mask-like stiffness. After correction the nose took on a normal, mobile, expressive appearance.

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CASE 10—A boy of 17 years of age had sustained a severe crushing injury of the nose when he was 8 years of age, which resulted in a complete absence of the bony arch of the nose. Only remnants of the superior maxillae were present. The problem consisted in making the nose as prominent as the skin would allow. After the bed was prepared and the lobule modified, a wide graft was inserted and, onto it, another smaller one (Fig. 4). Complete fixation of both grafts resulted.

COMMENT

Disease, injury and congenital anomalies may cause flattening or saddling of the nasal arch. It is not difficult to correct such deformities. The availability of an ideal material, the crest of the ilium, and the ease with which it may be procured, must encourage us to correct these deformities as often as the need becomes apparent. It is seen from the cases presented that the surgical procedures done at one time may include rhinoplasty, complete septum reconstruction, skin grafts on the inside of the nose, columella repair and lobule corrections. It is our feeling that healing is improved and takes place more quickly when all the procedures that are necessary are done at the same time. We have never seen a bone graft performed in the manner described which did not have a successful take. Several that seemed a little uneven in appearance at the completion of operation and during the early weeks of convalescence have, in a few months, smoothed themselves out and become completely adequate.

30 NORTH MICHIGAN AVENUE.

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XII

LATERAL SINUS THROMBOSIS

REVIEW OF RECENT LITERATURE AND REPORT OF A CASE

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With the advent of chemotherapy and, later, penicillin, there has been a natural but marked decline in the reports of intracranial complications of otitic origin. This paper deals with the literature from the first reports on sinus thrombosis treated with the combined procedures of antibiotics and surgery, or the former alone, until this date.

Hubert¹ reported on 95 cases of lateral sinus thrombosis from 1929 to 1936, and 24 cases from 1937 to 1940; the latter series was treated with the combined procedures. The first group showed a mortality of 32.6%, the second group, 12.5%. Singleton² pointed out that Herrel and Brown in a series of 274 cases showed that the recovery rate was almost doubled by the use of sulfonamides.

There is no doubt of the efficacy of the antibiotics in the treatment of severe middle ear infections. The great question, however, with which the literature abounds, is how much damage is produced in cases where the signs and symptoms are completely masked by the action of these agents on temperature, hematology and the over-all picture of many patients before the individual comes to the operating room. The pathological changes that continue under the cloak of antibiotic therapy must be a matter of conjecture to the physician in many middle ear infections thus treated; the treatment therefore incorporates watchful waiting.

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Kopetsky³ has cited "the need of conserving the hearing of patients with acute middle ear infections by avoiding undue prolongation of conservative therapy. In a patient who has an ordinary acute infection, who has classic symptoms and who is operated on promptly, healing takes place in the wound and resolution takes place in the tympanic cavity and the infection has not been established long enough to cause permanent and serious damage; hence, in the majority of patients thus operated on, the hearing is maintained. On the other hand, if a protracted course of conservative therapy has been followed, when the patient finally recovers there is considerable loss of hearing." This author is of the opinion that "an acute lesion should be permitted to develop and present its symptoms, so that the severity of the attack may be estimated; then, according to the course which the disease runs, the focal infection should be eliminated, after which sulfonamides should be administered."

In the same vein of thought Cirillo⁴ pointed out that every purulent otitis carries with it a number of intracranial complications, the early recognition of which is important. These complications are correctly diagnosed by the patient's general condition and appearance, the temperature curve, in the spinal fluid picture and the effect on the fields of vision and ocular fundi. The author stated that "since 1936, an entirely new approach to the problem of infection in the middle ear has been advocated. There is a tendency to prescribe chemotherapy to mastoiditis and its complications." He cited a series of 16 cases treated for sinus thrombosis before the advent of chemotherapy. Only one patient died despite the fact that seven of them had metastatic abscesses. He then discussed four fatal cases due to the masking of the classic symptoms of the complications of progressive otitis media. This author was adamant in his belief that chemotherapeutic temporizing with middle ear suppurations tends to delay life-saving surgical operations in cases of serious intracranial complications.

Many authors heartily endorse surgical intervention combined with antibiotic therapy in the majority of cases of mastoiditis and its complications.

Sauer and Woolsey⁵ have reported a case of thrombophlebitis of the lateral sinus, complicated by pregnancy, with complete recovery using this procedure. Birrel⁶ reported a case of lateral sinus thrombosis due to *Bacillus proteus*, with recovery. Rosenwasser⁷ reported on the last 100 cases operated upon at Mount Sinai Hospital:

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19 patients received sulfonamides postoperatively, with two deaths. The total mortality was 27 deaths in these 100 cases. Singleton² reported on six cases; his treatment included sulfonamides, heparin and surgical intervention. McCall and Freeman⁸ reported on a case due to Friedlander's bacillus treated with the combined procedure, with recovery. Adler and Klapper⁹ reported a case due to *Bacillus proteus* treated with the combined procedure, with death of the patient. However, their comment was that the perisinal and extradural abscesses present at the time of operation were not completely drained, and were probably responsible for the septic thrombi which caused the pulmonary infarct to which the patient's death can be reasonably attributed. Tresidder¹⁰ reported a case where, after the use of sulfonamides, a lateral sinus thrombosis was unexpectedly found at operation. He states that "this acute exacerbation of a chronic otitis media well illustrates the type of case in which sulfonamides are contraindicated as a sole preliminary form of treatment." Rosen¹¹ reported a very interesting case with typical history and physical and laboratory findings of lateral sinus thrombosis with metastasis to the knee joint and blood culture of hemolytic streptococcus. The treatment in this case was solely large doses of penicillin, as the patient refused surgery. However, the author stated that a combination of antibiotics and surgery may give the best results in the largest number of cases.

REPORT OF A CASE

J. M., a 26-year-old white male, was admitted on October 7, 1947, complaining of a painful left ear. The patient's history dated back to four years before admission when he experienced a discharging, painless left ear. This was treated with ear drops and sulfonamides. Since this episode the patient had had four other similar experiences at infrequent intervals. This symptom of painless aural discharge was not associated with acute coryza.

Approximately six days previous to admission the patient had developed painless aural discharge; local therapy was of no avail and about two days later the discharge ceased and pain became evident. There was slight, occasional vertigo, but to no severe degree. There was no history of vomiting or tinnitus. Slight to moderate deafness had been present since the first episode.

Examination revealed a well developed young white male in acute distress. No adenopathy was present. The eyes reacted to light and accommodation. The nasal septum was slightly deviated to

the right; the turbinates were normal. No exudate was present. The right ear was normal. In the left ear there was no tragal tenderness, but exquisite tenderness was present over the antrum and temporal region. The left canal contained a small amount of purulent, foul-smelling yellowish exudate. The tympanic membrane was thickened and no landmarks were evident. Two small polypi which were present along the posterior drum margin appeared to originate in the antrum. On lifting up the lower polyp a small amount of pus escaped. Whispered voice was heard on the right at 15/15; on the left at 5/15; the Rinne and Schwabach tests were negative, and the Weber lateralized to the left. There was no tenderness on compression of the jugular vein and no change in the type of discharge. Audiometric testing showed an 80-decibel loss in lower tones and speech range, and a 100-decibel loss in the 4096 and 8192 range. The mouth and throat were essentially within normal limits; the tonsils had been removed. The chest, lungs and heart were normal. Blood pressure was 120/80. The abdomen, genitalia, nervous system, etc., were all within normal limits.

The x-ray report stated: "The right mastoid is well pneumatized and the cells are mixed in type. There is no abnormality noted at this area. The left mastoid is of the same general type as the right and shows diffuse sclerosis with no evidence of air cells. There is a zone of radiolucency in the supratentorial portion of the mastoid in the temporal bone with several small areas of increased density. Impression: Chronic, sclerotic, left mastoiditis with probable superimposed acute disease. An acute infectious process in the left temporal bone is to be considered."

Wassermann and Kahn tests were negative. Urinalysis was normal. Ear cultures were not returned. The hematological study on admission showed: red cell count, 4.15; white cell count, 9,000; neutrophils, 65%; lymphocytes, 26%; monocytes, 5%; eosinophils, 3%; basophils, 1%; hemoglobin, 14.5 gm.; sedimentation rate, 28 mm./hr.

On the afternoon of admission the patient had a temperature of 101° F. (oral) and a pulse rate of 88. The only complaint was tenderness behind the left ear. That evening the temperature was normal but rose to 100° F. (oral) the following morning. The patient was put on penicillin, 100,000 units intramuscularly as the initial dose and 50,000 units intramuscularly every three hours. Later that evening, the temperature was normal and rose to 99° F. (oral) the next morning. A diagnosis of subacute mastoiditis with dural in-

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volvement was made and the patient was scheduled for a radical mastoidectomy on October 10, 1947, the third day following admission. On that morning the temperature was normal and the complaint the same: pain behind the left ear. On the elevator the patient had a violent chill and his temperature rose to 101° F. (oral).

Under general anesthesia a postauricular incision was made and the antrum entered directly by means of mechanical burs, with the release of a small amount of frank pus. In removing the cortex posteriorly, over the sinus, a large perisinus abscess was uncovered with the release of a large amount of pus pulsating under pressure. The sinus was exposed from the bulb to approximately 1 cm. from the torcula Herophili before active bleeding was encountered from the bulbar end. The entire sinus was necrotic and collapsed, the sinus wall being also soft and necrotic. Iodoform packs were placed between the bony overhang and the sinus at the torcular and bulbar ends, and the sinus incised. A thrombus, 4 cm. in length, was removed. The dura was then exposed at the sinodural angle and was seen to be red and injected. The mastoid cavity was completely exterminated of all necrosis and a vaseline packing placed into the cavity, which was left open. The left neck region was prepared and the internal jugular vein exposed with difficulty and ligated above the facial tributary; the vein was then severed. The patient was returned to the ward in good condition. Radical mastoidectomy was not completed at this time because the patient was too ill for further surgical procedure.

On the first postoperative day the temperature was 102.6° F. (rectal) in the morning and fell to 100° F. in the evening; on the second day the temperature ranged from 102° to 100.4° F. For these first 48 hours the patient had severe nausea and vomiting which cleared, leaving him symptom free. The fundi were examined and were found to be normal. On the third, fourth, fifth and sixth postoperative days the temperature ranged from normal to 101° F. (rectal). The hematological study on the second postoperative day showed: red cell count, 4.65; white cell count, 10,000 with a fairly normal differential count; sedimentation rate, 26 mm./hr.

On October 17, 1947, a radical mastoidectomy was performed, the drain in the left neck region was removed and a secondary closure of the neck wound was carried out. The iodoform packs were removed from the torcular and bulbar ends of the lateral sinus and no fresh bleeding was noted. A small amount of granulation tissue was seen in the mastoid cavity. Much necrosis and granulation tissue

was encountered in the antrum and in the middle ear, and inadvertently the stapes was removed. The patient returned to the ward in good condition.

On the first postoperative day the patient had severe nausea and vomiting, vertigo and spontaneous nystagmus to the right, stating that the room appeared to be revolving in that direction. The temperature was 100.4° F. (rectal).

On the second postoperative day he had the same signs and symptoms as the previous day but to a less marked degree. The temperature was 100° F. (rectal). The white cell count was 9,400 with a normal differential count and a sedimentation rate of 23 mm./hr. The patient stated that he was much more comfortable lying on his right side and looking upward to his left (slow component).

On the fourth postoperative day all signs of the acute labyrinthitis had disappeared and the temperature had returned to normal.

From this day the patient made an uneventful recovery with excellent epithelialization of the mastoid and middle ear cavity. Penicillin therapy was discontinued after 22 days' administration. On October 29, 1947, his twenty-second day in the hospital, the hematological study showed: red cell count, 4.0; white cell count, 5,600; hemoglobin, 14.0 gm. The differential count was within normal limits and the sedimentation rate was 10 mm./hr. The patient received a total of 6,100,000 units of penicillin and 168 gm. sulfadiazine. Cultures taken at operation were reported as *E. coli* two weeks later.

This patient's only complaint was pain in the ear and tenderness to pressure over the antrum and temporal region. Definite signs of intracranial complications were completely lacking until the patient was on his way to the operating room. The temperature of 101° F. (oral) on admission returned to normal 12 hours after the administration of penicillin. Our reasoning for performing the mastoidectomy (before the rigor) was that the present condition was due to a mechanical block of the purulent discharge with an increase in the pressure causing the pain and tenderness; surgical intervention was to prevent intracranial complications. The patient's history and his present acute symptoms with persistent mastoid pain and discharge led us to conclude that the present condition was an acute episode of chronic mastoiditis with pathological dural exposure.

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Discussion among the staff postoperatively brought up the question of the necessity of tying off the internal jugular vein in this case and in cases of lateral sinus thrombosis in general.

Hubert¹ stated that the treatment at the Manhattan Eye, Ear and Throat Hospital is as follows: "Free exposure of the lateral sinus. After iodoform plugs have been properly placed at the torcular and bulbar ends, the wall of the sinus and the thrombus, when one is present, is removed. Free bleeding is established if possible. When there is no bleeding from the bulbar end and sepsis is present, the jugular vein is ligated or resected.

"The present tendency is to carry out the necessary operations on the mastoid and lateral sinus. If sepsis continues and progress is unsatisfactory then ligation or resection of the jugular vein is considered in order."

Singleton² in his report on the recent developments in the treatment of lateral sinus thrombosis stated that he had found this question the most controversial in the management of septic thrombophlebitis of the lateral sinus. Ersner and Myers have pointed out that the pioneers in the field follow the hard and fast rule that the vein is to be ligated and the clot to be removed in all cases, while many of the outstanding otologists hold that ligation is seldom, if ever, indicated. It is thought that thorough exenteration of the mastoid cells with incision and drainage of the sinus appears to be adequate in most cases. Where symptoms of sepsis continue and there is evidence of involvement of the jugular vein, it should be exposed, ligated and drained. The author believes that the vein should be ligated before attempting to remove the clot in order to prevent liberating emboli into the blood stream.

Harkness believes that the logical therapy is operation on the mastoid process followed by observation of the clinical course. The procedure is surgical treatment of the sinus and continued observation, to be followed when necessary by ligation of the internal jugular vein.

Rosenwasser,⁷ in reporting the last 100 cases of lateral sinus thrombosis, based his treatment of the jugular vein on the thesis that if there is any doubt as to the safety of leaving the vein patent it should be ligated; at times, subsequent ligation was carried out, and in other instances obliteration of the lateral sinus sufficed to cure the general invasion. It is also interesting to note that in the

series reported there was no significant increase in the number of metastatic foci in the cases in which ligation of the internal jugular vein was performed together with the obliteration of the sinus. Portmann reported that he has had no deaths among his patients for an eight-year period, and explained his results on the basis of prompt surgical intervention with regard to both the lateral sinus and the internal jugular vein.

Koch¹² reported 44 cases in eight years with 12 fatalities. In 12 of the cases there were no signs of sinus thrombosis, yet the continuation of the high sepsis made an opening of the sinus necessary, together with the ligation of the jugular vein; he concluded that ligation of the vein alone is not sufficient for the prevention of bacteremia.

Blassingeme¹³ quotes Meltzer as stating that the majority of undesirable complications of lateral sinus thrombosis occur after ligation, and Ersner and Myers as saying that extension of the infection from the lateral sinus is retrograde rather than downward, and believing, for that reason, that ligation is superfluous. The author stated that the "similarity of the pathological aspects between lateral sinus thrombosis and abscesses in a general sense suggests that the same surgical procedures should be adapted to the management of the one as is universally practiced in the other, namely, provision for free drainage." The latter is carried out in an abscessed thrombus by adequate incision of the sinus wall, removing the obstructing detritus in the cavity and maintaining an avenue of escape for the disintegrating material. Blassingeme holds that complete removal of the clot is no more advisable than breaking down the protective wall of an abscess.

Other than the efficacy of tying off the internal jugular vein per se to prevent bacteremia and metastases, the problem of venous return from the head on the side involved in the otitic disease must be considered. Waltner¹⁵ pointed out that the variations of the lateral and sigmoid sinuses are independent of each other as they are evolved from different anlagen. The sigmoid portion shows greater constancy as the lateral sinus has to adapt itself to the increasing size and changing form of the surrounding structures, i.e., the brain and otitic capsule, while the sigmoid sinus is located close to the base of the brain from the very beginning of its development.

Mayfield¹⁶ divides intracranial edema, or, as it has been alluded to, "serous meningitis", "otitic hydrocephalus", "toxic hydrocephalus", "pseudo-abscess" or "cerebral edema", into two groups: one

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may be explained by an aseptic intracranial inflammatory process secondary to an extradural abscess; the other group, in which there is intracranial hypertension with choked discs and headache without cellular reactions in the spinal fluid, will occur in certain instances if the major sinus is occluded.

It has been established that the right lateral sinus is the predominant channel of venous return from the skull in the majority of persons. Studies by Woodhall in 1936 showed the right lateral sinus predominated in 29%; the left side predominated in 13%; the major disproportion between the two sides in 24%; inadequate cross circulation at the torcula in 10% and complete absence of one lateral sinus in 4%.

There it is noted that in approximately 25% the venous return from the skull is impeded when the predominant side is obstructed either by thrombus or surgical intervention. Fatality is evident if only one sinus is present.

Considerable significance can be attached to roentgenologic evidence of the size of the sinus and its capacity. Seydell¹⁷ states that Frenckner found that the relative size of the lateral sinus and the jugular foramen were proportionate in practically every instance, that is, when both sinuses were of equal size, the foramina were equal; when one sinus was smaller, the foramina of that same side showed a proportionate decrease in diameter.

In certain instances, the collateral circulation may be adequate to compensate after a period of time; in that event the patient will recover spontaneously. In others, decompressive measures may be required to protect the patient's eyes from atrophy as a result of choking of the discs and to save life.

Evans¹⁸ reports that the literature contains two cases of bilateral internal jugular ligation and reports a third with recovery. Seven cases of bilateral internal jugular ligation (not of otitic origin) were found in the literature. Precechtel lists the intracranial symptoms that may be noted in disturbances of the circulation in the cranial cavity: impaired consciousness increasing to unconsciousness, mania, apathy and amentia, headache, vomiting, retarded pulse, choked disc, affected sight ranging to blindness, convulsions, paresis of limbs, labyrinth irritation, disturbed heat regulation, glycosuria, polyphagia and obesity, aphasia and venoestasis of the face.

However, in the cases discussed by Evans, temporary papilledema and a variable amount of venoestasis of the head and neck were the only complications observed. Also, in the 16 patients with impaired cranial venous return, only three died, twelve completely recovered and in one the result is unknown.

Freisner,¹⁰ in discussing the ocular changes in otitic thrombosis, mentions dilatation of the veins, blurring of the disc margins, slight papilledema and marked papilledema as the most constant findings. However, there is no adequate explanation of papilledema, as those explanations which have been offered, viz., stasis, increased intracranial pressure and toxic state can all be challenged. Dean has stated that he has never noted evidence of papilledema from the blocking of the circulation in an uninfected sinus. The cranial sinuses are part of the dura and the one factor common to all these cases is the inflammation of the dura. It is possible that the latter, with its attendant edema and infiltration, may be an important factor in the development of papilledema with sinus thrombosis.

SUMMARY

This case and a review of the literature are being presented because of many interesting features: (1) The sulfonamides and penicillin produced a masked picture of extensive mastoid breakdown with extension and obliteration of the left lateral sinus. This process evidently was going on for some time and yet the patient was feeling fairly well, being up and about with no symptoms. (2) This patient postoperatively received penicillin while awaiting the return of the cultures taken at operation. Unfortunately they were not obtainable for a period of two weeks. The cultures were reported as *E. coli*; with this organism streptomycin would have been the drug of choice, but the patient evidently did very well on penicillin. (3) During the operation the stapes was inadvertently removed. The patient developed a moderate labyrinthitis but no other difficulty nor more serious complication resulted. (4) The ligation and resection of the jugular vein was carried out because at operation the thrombus extended down to and beyond the bulb, and the patient had had evidence of sepsis just before operation. As is well brought out in the literature, there is appreciable controversy as to the procedure of ligation and resection of the jugular vein, and one still must depend upon his own judgment at the time of operation.

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XIII

• ANGIOSARCOMA

A REVIEW OF THE LITERATURE

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Angiosarcoma is generally considered to be a very rare lesion. However, when the writer's own report²⁰ of such a neoplasm coincided with the publication of a similar case by Dr. Cruthirds,¹² the question was bound to arise whether angiosarcoma is actually as rare a disease as had been previously reported.

At first it was intended to submit merely a list of all cases reported in the literature, similar to the one compiled by Freilich and Coe¹⁵ for the years 1918 to 1934. While it is understood that all such lists are of necessity incomplete, the main difficulty in this instance lay in the fact that no agreement exists concerning the use of the term "angiosarcoma". Consequently, a number of different terms have been employed throughout the literature in order to describe malignant vascular tumors; thus, for instance, in the list of Freilich and Coe, cases diagnosed as angioleiomyosarcoma, telangiectatic sarcoma, systemic angiosarcoma, and cavernous angiosarcoma, appear side by side with others which are classified as angiosarcoma (hemangiosarcoma, lymphangiosarcoma). In addition to these terminologic difficulties there arise other problems due to the fact that some published reports do not sufficiently substantiate the proposed diagnosis. This has been recognized by Stout:³⁵ "In spite of the fact that blood vessels are ubiquitous, and benign vascular tumors exceedingly common, malignant tumors of blood vessels are exceedingly rare. Just how many of them have been recorded is impossible to say because many tumors have been reported as such with insufficient or obviously erroneous data. After reading reports of 118 cases labelled with some name suggestive of a malignant vascular tumor, the writer felt compelled to reject 41, or 35 per cent of them, either because there was an inadequate or no histologic report, or because, in his opinion, the illustrations and text described a tumor of some other kind."

Thus, the clinician is faced with the fact that the question of the incidence of angiosarcoma remains equally unsolved for the pathologist as it is for himself. Moreover, the issue underlying the prevailing terminologic difficulties, that is, the problem of the character of angiosarcoma, and whether there exist indeed true malignant vascular neoplasms, has not as yet been conclusively determined by the oncologists.

While Ewing¹⁴ merely reports on the issue without entering into a detailed discussion, the range of current opinions on the subject is well illustrated through the opposite views held by men like Stout on the one side and Willis on the other. Stout and his co-worker no longer speak of angiosarcoma per se, but rather treat of a number of different groups of malignant vascular tumors, including hemangioendothelioma,³⁵ hemangiopericytoma,³⁷ and either a vascular form of leiomyosarcoma or, on the other hand, Kaposi's disease.³⁶ Contrary to Stout's view, it is the opinion of Willis that vascular hamartomas as well as other types of vascular tumors have often been wrongly diagnosed as angiomas.⁴² Similarly, multifocal lesions have been classified as angiosarcomas.⁴² Even the distinction between benign and malignant angiomatous growths is by no means an easy matter.⁴¹ Of greatest importance, however, is Willis' observation that "the ready metaplastic conversion of proliferating mesenchymal tissue of one kind into tissue of another kind, seen in both non-neoplastic and neoplastic lesions, makes the grouping of mesenchymal tumors into separate species somewhat arbitrary ; . . . Predominantly angiomatoid structure in a mesenchymal tumor does not necessarily denote a specific vascular origin."¹² Willis concludes, therefore, that it is advisable "to regard true angiomas and angiosarcomas, not as a fixed species, but merely as conspicuously vasoformative variants of the genus mesenchymoma."⁴²

There can be little doubt that progress in the clinical understanding of angiosarcoma will remain greatly impeded as long as no effort is made to co-ordinate the opposing views of different pathologists. An attempt will be made here to integrate these seemingly irreconcilable opinions. To this end it is necessary to appreciate more fully the difficulties which sometimes are encountered in the differentiation of angiomatous tumors into benign and malignant neoplasms.

A number of cases have been reported in which large parts of the tumor present the structure of benign hemangioma, while in other portions of the growth, transition towards a sarcomatous ar-

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rangement is unmistakably evident;^{3, 22, 29} in some instances, the tumor is described as "partly sarcomatous";³¹ in others, repeated histologic examinations may be required in order to establish conclusively the diagnosis of a malignant vascular neoplasm.^{5, 6} While formerly metastatic spread originating from a benign hemangioma had been accepted as possible,¹⁸ Robinson and Castleman³⁰ concluded that "the occurrence of metastases should be the deciding factor and not the histologic features" and that, therefore, "the primary tumor, in spite of the absence of histologically malignant properties, was not benign." This opinion was confirmed by Stout³⁵ who, upon re-examination of the same specimen, discovered in certain areas of the neoplasm indubitable proof that the primary growth was after all not a simple hemangioma, but rather a hemangioendothelioma, that is, a malignant tumor according to his definition.

Practical conclusions of considerable importance may be drawn from these difficulties in establishing the true character of a vascular neoplasm. In the first place, tumors of this kind should never be excised without preceding histologic examination of a biopsy specimen; omission of this indispensable precaution may lead to recurrence or metastases, and is at least partly responsible for the high fatality rate.³⁶ A tumor specimen which is too small may not include any of the areas in which characteristic histologic or cytologic changes have occurred; similarly, correct diagnosis may prove impossible in the presence of infection.⁹ On account of these circumstances, no accurate determination can be expected when material obtained through aspiration or punching is submitted, and, if at all possible, a representative portion of the tumor should be surgically excised.³⁶ Whenever the histologic examination remains inconclusive, serial sections are required.³¹

Similar difficulties to those encountered in the distinction between benign and malignant vascular growths arise in the differentiation between vascular tumors and other types of neoplasms, as well as in the classification of malignant angioblastic growths. According to Magnusson²² there does not exist a typical microscopic appearance of angiosarcoma: "From foci with endothelium-like cells there are all sorts of transitions to tissue resembling fibrosarcoma with a fairly great amount of stroma"; furthermore, "it is impossible to decide which cells in the tumor originate from the endothelium, and which come from the adventitia." The indeterminate character of neoplasms of this type is well exemplified by a hemangiofibrosarcoma, in which angiomatous as well as fibrosarcomatous components were encountered.²⁷ A case which was clinically considered

a lipoma was microscopically diagnosed as xanthomatous angiosarcoma: within the vascular tumor little cysts filled with cells infiltrated by lipoid matter were found; the presence of xanthoma cells within the vascular tumor is traced to the pluripotency of the angioblasts.³² Still more varied neoplasms have been reported by other authors, as, for instance, a mixed mesenchymatous tumor presenting highly differentiated lipomatous, myomatous, and angiomatous components, together with groups of undifferentiated fusiform cells.³¹ DeNavasquez²⁵ discovered in malignant tumors of this type "potentialities to differentiate along several lines, either to the formation of well-defined vascular channels which remain primitive in form, or towards nondescript endothelium, occurring in bundles, whorls, papillary processes, or layers covering epithelial structures."

On the basis of all these observations, it might be possible to harmonize the seemingly opposing views of Stout and Willis outlined earlier in this paper, and also to indicate a tentative solution of the terminologic problem. According to Gemmill and Pusch,¹⁶ the present confusion is at least partly due to the fact that two different approaches can be used in order to arrive at a pathologic diagnosis: at times it is exclusively based on the histogenic approach, while in other instances it represents a formulation of the morphologic findings in a specific case, irrespective of the histogenesis. This state of terminologic uncertainty is indicative of the fact that in many instances of malignant vascular tumors, the microscopic findings do not bear a definite character. According to Stout, the morphologic features of sarcomas of this type are not equally distinctive as those characteristic of carcinomas; furthermore, it may prove impossible to ascertain the precise cellular origin of vascular sarcomas through examination of a single tissue specimen, or even through extensive morphologic investigations; cells explanted in vitro, on the other hand, grow in a manner representative of their origin, and such a tissue culture is often required in order to discover the true nature of a vascular tumor.³⁶

It may be concluded that in the prevailing state of medical science the histologic diagnosis of malignant vascular tumors is faced with a number of unavoidable obstacles. While a future solution of these problems may be expected, micropathologic findings at the present time do not seem to be sufficiently conclusive to permit generalization into unequivocal terms. On such an uncertain basis it is evidently impossible to formulate a classification of neoplasms of this kind which could be generally acceptable.

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The resulting terminologic confusion is by no means a purely theoretical problem. By reason of this uncertainty it is impossible to co-ordinate a sufficiently large number of cases of malignant vascular tumors. For lack of such well-founded tabulations we are at present unable to arrive at valid conclusions about the clinical appearance of these neoplasms, the course of the disease, or its statistical prognosis. Reliable information of this kind could be of great aid to the clinician. It is, therefore, desirable to establish a terminology which would permit the compilation of published case records, in order to make past experience available for future therapeutic practice.

Attempts at a generalization of some of the characteristic features of malignant vascular tumors for clinical purposes have been made in the past: Schmidt³² came to the conclusion that angiosarcomas are most often observed in the soft parts of the extremities. According to Stout,³⁵ about half of the number of all cases of hemangioendothelioma (in his definition, a malignant vascular tumor) appear during childhood or youth; in infants, the tumor presents as a rule a higher degree of differentiation and is, therefore, probably less malignant. On the basis of a case of their own and of four published cases, Ransom and Samson²⁸ were able to formulate a number of clinical signs of angiosarcoma of the greater omentum. Berezin, Sharnoff and Stein⁴ reported that clinical diagnosis has up to the present time not been possible in a single case of primary hemangioendothelioma of the liver in infants; but they suggested that under certain conditions the presence of this disease should be taken into consideration.

Still more important than these findings is the observation of Stout and Murray:³⁷ "The hemangiopericytoma emerges as a tumor which does not have sufficiently arresting gross features to enable one to recognize it clinically," and in almost all aspects "it behaves very much like other angiomatous tumors." Hemangiopericytomas, as defined by Stout and Murray, are, in the majority of cases, of benign character. Their observations, however, that some of the subgroups obviously required for a systematic description of microscopic findings are irrelevant from the point of view of classification for clinical purposes, are of equal importance with regard to malignant vascular tumors.

There exists, as shown above, no agreement concerning the highly differentiated terms used for the micropathologic distinction of malignant vascular tumors. It has even been suggested that many

of these minute differences exist merely during certain stages in the development of such neoplasms, but that they undergo anaplasia to homologous sarcomas with increasing malignancy.²⁸ In spite of these uncertainties, there can be no doubt that a set of highly differentiated terms is the prerequisite for accurate description and advance in the understanding of the histologic pattern of malignant vascular tumors. However, in view of a future statistical compilation from which valid conclusions about the clinical aspect of this disease might be drawn, there exists independently an equal need for a term which at the same time would have to be less controversial and more comprehensive. To this end, the expression "mesenchymoma of prevalently vascular appearance" might be acceptable. Willis⁴² speaks of the "conspicuously vasoformative variants of the genus mesenchymoma", while Courville and Abbott¹¹ discovered in certain tumors a "special propensity to form new blood channels." Thus the proposed term would have the advantage of gathering the pathologic experience into an easily understandable expression which might serve the practical purpose of a future tabulation of cases of "angiosarcoma".

On the basis of the present thorough, yet by no means exhaustive, search of the literature on the subject, it may be stated that angiosarcoma is not as rare a condition as had been assumed heretofore. While earlier statistical figures should not be uncritically accepted, it is nevertheless noteworthy that Simon³³ was able to collect no less than 41 cases of hemangioendothelial sarcoma of the thyroid alone. Tinozzi⁴⁰ reported a case of angioblastic sarcoma merely for the purpose of establishing a basis for discussion of the possible development of tumors from scar tissue. Bracco and Oghi⁸ published a detailed description of a special procedure of interscapulothoracic amputation, and mentioned incidentally an instance of reticuloangiosarcoma. While collecting material for an investigation of gemmangioma, Schmidt³² detected in seven and one-half years six cases of angiosarcoma at a moderate sized hospital; and besides, these cases are submitted only in order to substantiate Schmidt's theory of gemmangioma.

All these indications point to the fact that the rate of incidence of angiosarcoma is higher than formerly reported. Correct determination, however, will have to wait until, through unification and simplification of terminology, it will be possible to arrange the available case material into a comprehensive statistical tabulation.

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SUMMARY

1. The literature on angiosarcoma beginning with the year 1934 is reviewed.

2. At the present time, it is impossible to compile a reliably complete list of published cases, as a number of different terms have been used in order to classify identical or at least similar pathologic entities.

3. The histologic diagnosis of "angiosarcoma" encounters considerable difficulties, and even more specialized terms have been used in the description of microscopic findings.

4. For the purpose of a statistical tabulation from which conclusions about incidence and clinical features of the disease may be drawn, a more comprehensive term is required; to this end the use of the expression "mesenchymoma of prevalently vascular appearance" is proposed.

5. The present review of the literature leads to the impression that angiosarcoma is probably more frequently encountered than had previously been assumed.

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XIV

CARCINOMA OF THE ANTRUM

REPORT OF NINE CASES WITH A TEN-YEAR

SURVEY OF LITERATURE

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Carcinoma of the antrum is by no means a new subject. A perusal of the literature and some of the excellent articles of the past decade leave little room for doubt that the otolaryngologist is aware of its scope. The insidious onset is appreciated. It is now more frequently recognized. The gloomy outlook of early writings has been supplanted by some degree of optimism as diagnostic and therapeutic approaches have improved. However, it appears generally agreed that there is much to be accomplished by way of early diagnosis, which is tantamount to a favorable prognosis. There is still too much time lost between the appearance of the first signs or symptoms and the start of actual therapy. In an attempt to determine some of the manifestations leading to early diagnosis, nine cases, eight of which were observed at the New York City Hospital and one private case, are presented, and literature of a ten-year period, from 1935 to 1946 inclusive, is reviewed.

REPORT OF CASES

CASE 1.—The patient, a 67-year-old white woman, was admitted to the hospital on November 11, 1943. Her chief complaints were swelling of the right eye and difficulty in swallowing. The history was unsatisfactory because of her mental condition. She was said to have had a convulsion the evening before admission, about two hours after taking a sedative.

She had been operated on at another hospital five weeks before. At that time the chief complaint was bilateral nasal obstruction of six months' duration, repeated epistaxis and headache for three months, and protrusion and loss of vision of the right eye for one month. Physical examination revealed marked proptosis of the right eye with chemosis of the conjunctiva and complete loss of vision to light perception. The left eye showed a loss of the nasal field of vision, otherwise it was normal. There was complete obliteration of the nasal airway due to a tumor mass and marked swelling of the mucous membranes with bilateral mucopurulent

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Fig. 1.—Photomicrograph. Case 1. Specimen of antral lesion showing carcinoma of adenoides cysticum type (x 90).

discharge. The right maxilla was swollen with a palpable, hard tumor mass. Downward extension of the tumor had resulted in ulceration of the hard palate on the right side.

X-ray films revealed a far advanced destructive process of the right antrum and right ethmoid. In addition, there was destruction of the medial portion of the floor of the right orbital fossa. The right sphenoid sinus appeared destroyed and the anterior portion of the sella turcica was involved. The process had extended through the floor of the antrum with considerable destruction of the hard palate on the right side and partial invasion of the left antrum. Specimens taken from both antra showed carcinoma with squamous and cystic features on the right and mainly cystic features on the left. The pathological diagnosis was epithelioma adenoides cysticum. The therapy was irradiation; the patient received 2000 "r" units to the right antrum and later 1250 "r" units to both antra.

On admission to City Hospital the patient appeared chronically ill and cachectic. The face was asymmetrical and the right side edematous. The right angle of the mouth drooped and the tongue deviated to the left. The left upper tendon reflexes were absent, the right were present. There was a definite left Babinski and an equivocal right Babinski sign.

X-ray films revealed in addition to the findings at the other institution, an extension of the process with destruction of the right anterior clinoid, a destructive lesion of the tenth right rib posteriorly, a fracture of the left eighth rib in the axillary line, and a productive infiltration of both upper pulmonary lobes with abscess formation.



Fig. 2, Case 9.—X-ray film showing erosion of floor of the right orbit by squamous cell carcinoma of the right antrum.

There was clinical evidence of a cardiac decompensation. She was transferred to a home for incurables two weeks later, where she died on November 30, 1943. Permission for autopsy was not obtained.

Permission for autopsy was not obtained.

The total duration of recognized carcinoma was two months.

CASE 2.—The patient, a 57-year-old white laborer, was admitted on July 3, 1944. The chief complaint was pain in the head and roof of the mouth. He was first seen by his private physician on January 24, 1944. At that time he gave a history of pain over the left side of the face of several years' duration and the extraction of two upper left molars five weeks previously. At the site of extraction there was a large ulcerated mass, a specimen of which was obtained by biopsy and proven to be squamous cell carcinoma. A resection of the antrum was performed with the complete removal of the medianasal wall and part of the roof of the mouth. A large mass of carcinoma was readily stripped from the lateral and posterior bony walls. The orbital floor appeared uninvolved. A course of deep x-ray therapy was instituted.

On admission to this hospital he was co-operative and appeared chronically ill. The breath was extremely foul and most of the teeth were missing. There was a crusty mucoid discharge from the nose. The left cheek was pigmented from x-ray therapy. There were no other pertinent findings.

He was discharged to Cancer Hospital two days later for custodial care, and he died there on July 31, 1944. Permission for autopsy was not obtained.

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Fig. 3, Case 9.—High power photomicrograph of squamous cell carcinoma.

The duration of recognized carcinoma was four and one-half months.

CASE 3.—The patient, a 51-year-old Japanese, was admitted on June 4, 1945, with the chief complaint of pain in the right side of the face for four months. He stated that he had had right sinusitis all his life, and an operation had been advised 30 years previously. On examination the right side of the face, including the eye and temporal region, appeared swollen and was considerably tender. The right nasal cavity was completely obstructed. Decongestion was followed by a flow of putrid yellow pus. There was a slight postnasal discharge. There were no other pertinent findings. The temperature was 99.2° F.; pulse, 88; and respiration, 18.

X-ray films showed a far advanced destructive lesion of the bones of the right antrum to the roof, the adjacent portions of the right ethmoidal cells, the zygoma and right supra-orbital area. There was extensive soft tissue swelling in the right frontal and ethmoidal areas and right nasal cavity. The left antrum had moderate mucosal thickening.

A Caldwell-Luc procedure with wide intranasal antrotomy was performed. Thick putrid pus flowed from the cavity as soon as it was entered. The mucosa throughout was polypoid, its removal from the posterior and lateral walls causing moderate bleeding. The bone encountered was very friable.

Pathological examination showed squamous cell carcinoma.

He was transferred to Cancer Hospital two weeks later where he received a course of x-ray therapy totalling 2,000 "r" units to the field. Death occurred on August 30, 1945. Permission for autopsy was not obtained.

The total duration of recognized carcinoma was six months.

CASE 4.—The patient, a 71-year-old white woman, was admitted on March 8, 1946. The current illness dated back two months. She first noticed a small subcutaneous swelling of the right cheek which was constantly painful and throbbing and accompanied by marked serous discharge from the right nostril. The mass continued to grow, all the symptoms increased in severity, and on admission the chief complaint was constant severe throbbing pain in the right maxillary region. During the previous month there had been mild pain in the right frontoparietal region with loss of hair at this site. During the last two years, there had been a 40-lb. weight loss. The only previous illness was a coronary attack three years before. Since then she had been on digitalis therapy. Her father had died of gastric cancer at the age of 54.

Examination showed an obese female in no acute distress. The right frontoparietal area was sparse of hair. In the right maxillary area there was a palpable firm diffuse swelling extending from its medial to its lateral border and giving a sensation of induration. The right lower eyelid was swollen and the eye proptosed. The nasal mucosa was edematous and hyperemic. There was a small mass presenting into the nose under the right inferior turbinate. The septum deviated to the right. Otherwise the physical examination revealed nothing relevant. The blood pressure was 160/85.

X-ray films showed right maxillary antral clouding with destruction of the floor of the orbit. Lipiodol studies showed marked narrowing and deformity of the right antrum, extending from the roof to the medial orbital region.

A modified Caldwell-Luc operation was performed. On incision into the right canine fossa, the anterior wall of the sinus was found completely eroded and replaced by a rubbery, spongelike mass which occupied the antral cavity but had not yet infiltrated the soft tissues of the cheek. Medially, the mass had eroded the wall with a small extension into the nose. As complete an exenteration as was possible was done by electrocautery.

A course of deep x-ray therapy was begun, but interrupted when the patient insisted on being allowed to go home. Inasmuch as the involvement was so extensive, it was felt that the case was hopeless and she was released. Pathological examination showed primary squamous cell carcinoma of the antrum.

She died on July 7, 1946. As far as is known, no autopsy was performed.

The total duration of recognized carcinoma was six months.

CASE 5.—The patient, an 80-year-old white woman, was admitted on August 12, 1943. She had suffered from left maxillary sinusitis for ten years. Four weeks previously left nasal obstruction was discovered on attempting to irrigate the nose with tepid boric acid. At the same time it had been noticed that the left cheek was becoming swollen and red. For the last three or three and one-half years she had had postnasal "drip" in the morning. During the last two years, she had lost 75 lbs. in weight. On examination the patient was co-operative and not in any acute distress. The left cheek was swollen and red, there was purulent discharge in the left median epicanthus suggestive of occlusion of the nasolacrimal duct and dacryocystitis. The left nostril had a polyp presenting and there was a circular, edematous, tender area over the left maxillary sinus. In the mouth, about the site of the second left molar, was a small cyst measuring 3 cm. by 3 cm. The upper teeth were missing, the few remaining lower ones were carious. There were no other pertinent findings. The temperature was 99.6; pulse, 100; and respiration, 24. The swelling increased after admission to involve the lower eyelid and malar region. Slight pressure forced pus through the lacrimal duct.

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Roentgenological study showed diffuse clouding of the left maxillary sinus, left nasal cavity and left anterior ethmoidal cells, and destruction of the lateral and inferior walls of the maxillary sinus. There were several roots present in the upper jaw. One was removed; the swelling in the molar region increased and was incised and drained.

On the sixth hospital day, polypi were removed surgically from the left antrum by the Caldwell-Luc procedure, and from the lower and middle meatuses by a snare. There was little bleeding and the left antrum and nose were packed. There was a slight febrile response for two days.

Pathological examination showed polypi, anaplastic squamous carcinoma being present in one mass.

She was transferred to New York City Cancer Hospital on September 23, 1943, for x-ray therapy. She died on June 23, 1944. Permission was not obtained for autopsy.

The clinical history raises two interesting questions. Why should a 70-year-old individual suddenly develop sinusitis? Should this have suggested the possibility of sinus malignancy?

The total duration of recognized carcinoma was one year.

CASE 6.—The patient, a 67-year-old white man, was admitted on May 3, 1945. He had been under treatment at Memorial Hospital since November 21, 1944, for carcinoma of the left antrum. The findings at that time indicated extensive destruction of the maxillary bone, and invasion of the left orbital floor. Biopsy confirmed the presence of carcinoma. He had received high voltage x-ray therapy throughout two lateral portals, total dosage 4,200 "r" units, with marked regression in the tumor and considerable relief from discomfort for about two months. In March, evidence of metastatic involvement appeared; first, a lymphatic cervical node and later, subcutaneous involvement at the angle of the jaw. The cervical node was treated by three doses of radon seeds, total 28 mc. The subcutaneous involvement was treated by 3,000 "r" units of high voltage therapy. There was not much regression.

He was referred for custodial care and transferred to Cancer Hospital, May 10, 1945, where he died 18 days later. Autopsy revealed squamous cell epithelioma of the left antrum with metastases to the cervical lymph nodes, pleurae and right first rib.

The total duration of recognized carcinoma was six months.

CASE 7.—The patient, a 55-year-old white man, messenger by occupation, was admitted on April 7, 1947. He had noted increasing fatigue and exertional dyspnea for the past three weeks. For two years he had a cough initiated by postnasal "drip". The cough which was productive of yellowish sputum was becoming progressively more severe, being worse in the morning when it occasionally caused vomiting, and in the evening. More recently the sputum had become blood streaked. He had had "sinus trouble" for one year. For the past week there had been pain over the right side of the face and a sensation of "pins and needles". There had been a recent weight loss of 15 lbs. during the last two to three weeks. There was nothing else of note. On examination he appeared well nourished and well developed. The region of the right antrum was tender. There was a discharge from the right nostril and the septum was deviated. The heart was enlarged. The blood pressure was 190/75, and he had double apical and aortic murmurs. He was considered in mild cardiac decompensation and was treated accordingly.

X-ray examination showed the right antrum to be completely obliterated and the right frontal sinus moderately cloudy. The remaining sinuses were clear.

The right antrum was explored by the Caldwell-Luc approach with a 2-in. incision in the bucco-alveolar fossa. The bone bled profusely. There was a defect admitting the tip of the little finger in the canine surface of the right maxilla, filled with soft, gray, easily bleeding tissue growing out into the muscles of the cheek. The bony defect was enlarged and as much tissue as possible removed from the antrum with "cold knife" followed by cautery.

Pathological examination showed squamous cell carcinoma.

He was transferred to Cancer Hospital on May 29, 1947, for x-ray therapy. He died on October 17, 1947.

The total duration of recognized carcinoma was six months.

CASE 8.—The patient, a 59-year-old negro, was admitted on August 3, 1945. He first came under medical observation in another institution on July 10, 1941. At that time he had a tender, hard swelling of the right superior maxillary region of one month's duration, becoming progressively worse. It was accompanied by right nasal blockage and profuse purulent foul discharge. Usually the discharge was bloody, sometimes almost hemorrhagic. There was considerable recent weight loss. He appeared well developed, poorly nourished, rather uncomfortable, and had a slight temperature. Over the right maxillary region was a firm, slightly nodular, tender swelling. There was profuse foul discharge from the right nostril. The right lower and middle turbinates were large and red. The left nostril was clear. The root of a molar tooth was present in the right upper jaw. The pharynx was red and there was some postnasal discharge. The right cervical lymph nodes were palpable. The edge of the liver was palpable 1 cm. below the costal margin and was slightly tender. Other findings were noncontributory. A biopsy specimen of the right side of the nose was diagnosed as squamous cell carcinoma. Three dental extractions were done subsequently. On repeated antral irrigations with a Coakley trocar almost the entire bony medial wall was found destroyed by tumorous tissue. X-ray therapy and sulfathiazole by mouth were almost without result, the foul smelling discharge persisting unchanged. Polypi and the anterior tip of the right middle turbinate were removed in an attempt to obtain better drainage. Sulfathiazole was instilled into the antrum and later azochloramid was substituted, still without any effect on the discharge. On December 11, 1941, a radical antrotomy with removal of the entire floor of the antrum was performed under general anesthesia. Electrocautery was used, preceded by ligation of the right common carotid artery. Feedings by a stomach tube were instituted. Eleven days later he developed a spontaneous pneumothorax which was confirmed by x-ray examination. Recovery from this was uneventful. The antral cavity began to clear, the granulation tissue was healthy looking and very little discharge was present in the daily dressings. He was finally able to eat soft foods by mouth. There was no discernible extension of the carcinoma and his general condition was satisfactory when he was transferred to Cancer Hospital on February 25, 1942.

While at Cancer Hospital, he attempted suicide several times, once by jumping into the river. On being rescued he was admitted to City Hospital via ambulance, suffering from submersion. After recovery he was transferred to a psychopathic hospital. At present he is a patient in a state mental institution. The antral condition, as far as is known, is satisfactory.

This patient is still alive and apparently free of recurrence seven years after operation.

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CASE 9.—The patient was a woman 40 years of age. The current illness was of three months' duration. The presenting features were swelling about the right eye and headache. They were followed in one month by right nasal obstruction and discharge. Protrusion of the right eye developed two weeks later. There was a weight loss of 7 lbs. during the current illness. She had been treated conservatively with nasal packs and irrigation for two months with no improvement. At this time she came under our observation.

On examination the right eyelids and cheek were swollen and the eye exophthalmic, protruding 5 mm. In the floor of the orbit, a firm but resilient mass continuous with bone was palpable, extending along the entire floor from the internal to external canthus. The extra-ocular movements were intact, diplopia was absent and the fundi were normal. The right naris was occluded by a large middle turbinate bathed in pus.

X-ray examination revealed, in the right antrum, a marked density resembling a polypoid change, complete erosion of the infra-orbital margin and naso-antral wall, erosion of the floor of the right orbit, and invasion of the nasal cavity. The left antrum seemed to be filled with a material of the density of bone, especially marked on the posterior wall, which was evidently bone proliferation. The ethmoid sinuses showed severe involvement from extremely dense tissue; there had been complete absorption of all cell structure on both sides. The sphenoid sinuses were extremely small and practically obliterated by dense material. The frontal sinuses showed mild mucosal thickening. The only change in the skull was an osteitic thickening of the lesser wing of the sphenoid bone. The interpretation was a malignant growth involving the right antrum, possibly extending into the left antrum, and also involving the right nasal cavity.

Cautery antrotomy, after preliminary ligation of the right external carotid artery, disclosed a large tumor mass completely filling the right antrum, which had destroyed the anterior face of the superior maxilla and had invaded the inferior orbital plate and the right lateral naris. Pathological examination showed squamous cell carcinoma.

The therapy consisted of gold seeds on three occasions, given three days apart as follows: 1) 14.21 mc. through antrotomy into the upper anterior and lateral aspects of the roof; 2) 15.28 mc. through antrotomy into the lower posterior and medial aspects; 3) 16.05 mc. through antrotomy into the upper and anterior portions.

The exophthalmos increased, the vision was failing and enucleation became necessary approximately seven weeks after operation. Two weeks later the patient developed meningitis and became completely disoriented. A severe hemorrhage, approximately 750 cc., from the wound occurred two days later. It was controlled by packing. The following day the patient expired.

The autopsy diagnoses were septic surgical defect of the face, posterior right antrotomy and exenteration of the right orbit, basal meningitis, cerebral abscess and thrombosis of the right ophthalmic vein. There was no microscopic evidence of residual tumor.

The total duration of recognized carcinoma was three months.

Anatomy. The antrum is one of the earliest of the paranasal sinuses to develop, being known to be present as a small slit in the first half of intra-uterine life (Barnhill¹).

TABLE 1.
AVERAGE MEASUREMENTS OF THE ANTRUM AT BIRTH
AND AT FIFTEEN YEARS OF AGE.

AGE	LENGTH	WIDTH	HEIGHT
At Birth	7 - 8 mm.	3 - 4 mm.	4 - 6 mm.
At Fifteen Years	31 - 32 mm.	19 - 20 mm.	18 - 20 mm.

The largest of all the paranasal sinuses, when fully developed it is pyramidal in shape with its apex situated laterally at the side of the articulation of the malar bone with the superior maxilla, and with the base against the lateral wall of the nasal cavity. The upper wall is thin and forms the floor of the orbit. It contains the infra-orbital canal through which run the infra-orbital artery and nerve. The latter, from the second division of the fifth nerve, gives off numerous branches to the face. From the floor of the orbit the fifth nerve gives off the anterior, middle and posterior superior alveolar branches, which, in addition to providing the antral mucosa with sensation, supply all the upper teeth. With this in mind, sensory disturbances in the cheek and teeth encountered in carcinoma of the antrum can be better understood.

The lower wall is somewhat thicker and lies above the alveolar process in close relation to the teeth.

The inner or naso-antral wall is usually thin and has the nasal turbinates attached. It contains the maxillary ostium.

The lymphatics of the antrum and those of the other paranasal sinuses connect with those in the nose mainly about the natural ostia of the sinuses. The posterior nasal lymph current empties into the retropharyngeal lymph nodes, while others penetrate deeply through the muscles of the nasopharyngeal region to nodes around the carotid and jugular sheaths in the neck (Eggston and Wolff²).

Histology. According to Sobotta-Piersol,³ the antral cavity is lined by a relatively thin mucous coat which has a simple ciliated epithelium and few glands or none at all.

According to Eggston and Wolff,² the antral cavity is lined with pseudostratified columnar epithelium with a few goblet cells which may be irritation forms of columnar cells. These goblet cells increase in number when there is irritation of the structures. The glands, though few in number, are found in greater proportion in

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the antrum than in the frontal, ethmoid, or sphenoid sinuses, though less than in the turbinates. These glands are more frequent on the mesial wall.

Pathology. According to Harmer⁴ and Geschickter,⁵ 60% of nasal growths are carcinomas; 30% are sarcomas and 10% endotheliomas.

The antrum is the most frequently involved of the paranasal sinuses, the ethmoid, sphenoid and frontal being less frequently involved in the order mentioned.

Antrum cancers originate from the lining mucous membrane. In most cases, they are slow growing and metastasize late and infrequently as long as they are contained within the intact cavity of the sinus. Extension of the growth may occur by contiguity or by true metastases. By contiguity, the palate, nasopharynx or face become secondarily involved, as the bony wall is eroded. By true metastases the deep cervical glands are most frequently involved followed by the cervical vertebrae, lungs and brain, in order of frequency.

They may arise from surface epithelium or from glands. Histologically, those arising from the surface epithelium may be characterized by columnar cells, transitional cells, squamous cells, anaplastic cells, or by an adenoides cysticum architecture. Those arising from glands are adenocarcinomas.

The most common type of cancer of the antrum is the squamous carcinoma; the transitional and columnar types are uncommon. The epithelioma adenoides cysticum is classed by Ewing as a basal cell carcinoma because it resembles one type of basal cell carcinoma found in skin. It is very unusual among antral carcinomas. Many tumors, although classifiable in other groups, may have areas showing marked anaplasia or the entire tumor may have that character. The adenocarcinomas are uncommon probably because glands are infrequent.

New and Cabot⁶ present a series of 141 malignant tumors of the antrum, of which 91 are apparently primary and 50 apparently secondary. Of the 91 primary tumors, 63 were squamous cell carcinomas; 6 adenocarcinomas; 2 of undetermined cell type and the remainder were various types of sarcoma. Of the 50 secondary tumors, 30 were squamous cell carcinomas; 5 adenocarcinomas; 11 of undetermined cell type and the remainder sarcoma.

Etiology. It is thought by some authorities that chronic supuration is an etiological factor in malignancy of the antrum. Ex-

TABLE 2.
PROPORTION OF MALIGNANT SINUS GROWTHS IN COMPARISON TO THE NUMBER
OF ADMISSIONS OVER A SPECIFIED PERIOD OF TIME.

Name of Institution	Period of Time	Number of Admissions	Number of Cases Involving Sinuses	Type of Involvement
New York City Hospital	1935-May, 1947	113,391	8	Carcinoma of the antrum
Brooklyn Cancer Institutes ⁸	1937	737	5	Malignant tumors of sinuses
Central London Nose & Throat & Ear Hosp. ⁹	1927	1,292	5	Malignant disease of nose and sinuses
" "	1937	2,602	10	" " "
Foundation Curie of Paris ¹⁰	1919-1934	Not stated	72	Epithelioma of antrum.
Bristol Royal Hospital, Bristol, England ¹¹	1929-1935	Not stated	18	Malignant tumor of maxillary and ethmoids
Jewish Hospital, Brooklyn ¹²	1932-1934	Not stated	3	Neoplasm of the antrum
St. Bartholomew's, Mt. Vernon Hosp. and private practice ⁴	1920-1935	Not stated	70	Carcinoma of upper jaw and antrum
Los Angeles County Hospital ¹³	Not stated	Not stated	50	Carcinoma (43), melanoma (1), sarcoma (5), endo-thelioma (1)
Memorial Hospital, N.Y. ¹⁴	1928-1938	26,062	127	Carcinoma of paranasal sinuses
Tata Memorial Hospital, Bombay, India ¹⁵	Not stated	4,800	55	Carcinoma of the antrum
Sabbatsberg Clinic, Stockholm, Sweden ¹⁶	1924-1936	Not stated	235	Malignant maxillary tumors
Groningen Hospital ¹⁷	In 12 years	Not stated	35	Carcinoma (25) Sarcoma (10)
1st Surgical Clinic of Peter Pazmany, University of Budapest ¹⁸	In 17 years	Not stated	70	Carcinoma (63), malignant tumor of the nasal sinuses (7)

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ternal trauma to the face has been considered of etiological significance in the development of carcinoma. Geschickter states that benign papillomas in the antrum may give rise to epidermoid carcinoma with a papillary structure. New and Cabot refer to "papillary leukoplakia" as a potentially malignant state.

Both these conditions suggest the possibility that the papillomatosis and the papillary leukoplakia may be sequelae of preceding inflammatory disease. As far as could be determined from the literature, papillomatosis in the absence of inflammatory disease is unknown. Leukoplakia of transitional epithelium at other sites in the body is known to be quite frequent in the presence of chronic irritation or chronic inflammatory disease.

There appears to be nothing in the etiology which has a direct bearing on occupation or exposure to irritant dusts or vapors.

Incidence. Although carcinoma is the most frequent of the malignant growths of the antrum, it is still uncommon.

Ewing⁷ claims that at the Memorial Hospital 2.5% of all cancers arise in the nasal passages and their accessory sinuses, and that 75% of this group involve the maxillary antrum. Apparently, however, these include both primary and secondary antral tumors.

In a series of 6,226 autopsies at New York City Hospital from January 1, 1920, to December 31, 1946, 809 were cases of carcinoma, but none of these involved the antrum.

In a series of 2,724 cases of carcinomas admitted to the same institution from 1935 to 1946, there were 8 cases, or 0.29%, of carcinomas of the antrum.

Table 2 shows the proportion of malignant sinus growths in comparison to the number of admissions in various hospitals as noted, over a specified period of time.

Race, Sex and Age. Race appears to have no relationship to the development of this condition. Lewis¹⁹ states that there is a smaller percentage of malignancy in the negro than in the white race.

Males are more susceptible than females in the proportion of 350 males to 274 females. In the present series of cases, the proportions were 5 males to 4 females. The average age of these was

63 years (males, 58 years; females, 70 years). The most frequent age of patients with carcinoma of the antrum, according to the literature, is 50-60 years (males), and 60-70 years (females). The one private case in this report is a woman aged 40 years.

The number of acceptable carcinomas found in the review of the literature is 517. There are 107 further cases reported as malignant disease, which may or may not be carcinoma. The data in relation to age and sex are summarized in Table 3.

TABLE 3.
AGE AND SEX DISTRIBUTION OF PRIMARY SINUS
CARCINOMAS.

Age Group	Male	Female	Type of Involvement
0-10 years	--	--	--
10-20 years		1	Solid cylindric cell carcinoma ²⁰
		1	Cellular sphenoid celled carcinoma ²¹
20-30 years		2	Adenocarcinoma ²⁰
		2	Squamous carcinoma ²⁰
	1	2	Malignant tumor of sinuses ²¹
			Carcinoma of the maxillary sinuses ²²
30-40 years	1		Adenocarcinoma ²³
	4	3	Squamous cell carcinoma ²⁰
		1	Carcinoma of antrum ²⁴
40-50 years	6	2	Adenocarcinoma ^{20, 23}
	48	43	Primary malignancy of antrum ⁶
	1		Undifferentiated carcinoma of antrum ²⁵
		3	Malignant tumor of sinus ²¹
50-60 years	41	12	Carcinoma of antrum ^{13, 26-28}
	1	2	Malignant tumor of sinus ²¹
	5	4	Adenocarcinoma ^{20, 24}
	1		Tumor of maxillary sinuses ²⁹
	1	1	Epithelioma of maxillary sinus ^{30, 31}
	36	19	Carcinoma of maxillary sinus ¹⁵
	82	44	Carcinoma of paranasal sinus ¹⁴
60-70 years	13	13	Solid cylindric cell carcinoma ²⁰
	1		Carcinoma of maxillary sinus ³²
	98	111	Squamous cell carcinoma ²⁰
	5	7	Undifferentiated carcinoma ²⁰
	1		Epithelioma of maxillary sinus ³³
	1		Malignant neoplasm in maxillary sinus ³⁴
	2		Malignant tumor of sinus ²¹
70-80 years		1	Carcinoma of maxillary sinus ²²
	1		Malignant tumor of sinus ²¹
TOTALS	350	274	CARCINOMAS 517 CARCINOMA(?) 107

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Clinical Features. Early diagnosis of carcinoma of the antrum is of primary importance. The signs and symptoms which should suggest antral carcinoma are a unilateral discharge, nasal obstruction, epistaxis, ulceration of the hard palate, paresthesia or anesthesia, lacrimation, pain, malar prominence, exophthalmos and diplopia.

Unilateral Discharge. The discharge may be serous, mucoid or purulent. The onset may be sudden or insidious. A sudden onset of unilateral discharge where no nasal disease existed before is very suggestive.

Nasal Obstruction. The obstruction is at first unilateral when associated with an intranasal extension. As the growth increases it becomes bilateral. It may be an early or a late sign. Obstruction may also result from associated polypi.

Epistaxis. Epistaxis is generally unilateral, occurs spontaneously, is usually late and without any visible bleeding point.

Ulceration of Hard Palate. Nuttall³⁵ showed that in a series of 96 cases of malignant ulcer located at "typical antral sight" (junction of the middle and anterior thirds of the alveolus), the maxillary antrum was involved at some period in 94%.

Paresthesia or Anesthesia. Paresthesia or anesthesia of the cheek on the involved side may result from lesions originating from the posterior, superior, central wall, with associated pain referred to the teeth. This is a late manifestation.

Lacrimation. Lacrimation may occur with or without external swelling. It is usually the result of extension of the growth into the maxillo-ethmoidal region and is a late manifestation.

Pain. Pain is a late symptom. Tumors located in the anterior superior wall may cause pain in the eye. With extension laterally, they may be associated with swelling of the cheek. Backward extension to the intratemporal and pterygopalatine fossae produces "neuralgic-like" pain in the maxillary nerve area.

Malar Prominence. Malar prominence is usually a late sign and results from erosion of the anterior bony wall and involvement of neighboring structures. It is a bad sign, for once this wall is eroded progression of the tumor through the soft tissues is rapid.

Exophthalmos. Exophthalmos results from actual extension upward into the orbit, and is usually a late sign.

Diplopia. Diplopia may likewise result from actual extension upward into the orbit and is also a late manifestation.

The above signs and symptoms are of especial importance when occurring in an individual between 50 and 70 years of age.

Roentgenology. Roentgenology in the early stages of carcinoma of the antrum is of limited value. Carcinoma is a soft tissue growth. It produces a shadow similar in appearance to masses of inflammatory nature. In the roentgenogram the neoplastic and non-neoplastic masses cannot be differentiated. Furthermore, exudate which is present both in malignant and nonmalignant lesions of the antrum adds a further confusing factor. The first positive sign of malignant disease by roentgenogram is erosion of the bone.

Inflammatory disease of the bony wall causes decalcification. This results in faintness of shadow of the entire portion involved.

Malignant neoplastic disease results in bone destruction by invasion. At first, a small portion of the bony wall will be invaded and completely destroyed while all of the adjacent bony wall appears normal.

It is this sharp change from normal bone to completely destroyed bony wall which is characteristic of malignant neoplastic disease.

Unmistakable evidence of malignancy already denotes extension beyond the cavity.

Other Aids to Diagnosis. Any patient past the fourth decade of life with clinical findings suspicious of malignancy, regardless of the x-ray report, should have a biopsy performed and repeated if necessary. Tissue aspiration for microscopic examination according to the method of Martin and Ellis is of some value, but inconclusive if negative. Transillumination may be of considerable value in unilateral lesions where a dense shadow is found on the affected side.

Differential Diagnosis. The main conditions from which carcinoma of the antrum must be differentiated are chronic sinusitis, polypi, osteomyelitis, secondary malignancy, benign tumors, specific infections, neuralgia or tic douloureux, and blood dyscrasias.

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Chronic Sinusitis. Chronic sinusitis is more apt to be bilateral with a history of long duration and is relieved by conservative measures. A unilateral refractory sinusitis should immediately suggest underlying neoplasm. This point is illustrated by Case 8.

Polypi. Polypi may have an allergic or an infectious background. They should be sectioned for pathological diagnosis. After removal of polypi the antrum should be investigated to rule out masking of an underlying malignancy. Case 5 illustrates this point.

Osteomyelitis of Maxilla. Osteomyelitis of the maxilla usually is of dental origin. Roentgenology is of value in differentiating this condition from primary antral disease.

Secondary Malignancy. The differentiation between a primary and a secondary malignancy of the antrum may be difficult or impossible. Lederer³⁷ feels that "it is misleading to apply the term 'Primary' to a carcinoma in any given sinus, and especially the antrum." Malignant tumors of the sinuses are infiltrative and rarely confined to the walls of one sinus. The possibility of origin from a para-antral site such as in the case of adamantinoma or carcinoma of the palate must be investigated. The antrum may have to be explored before differentiation can be made.

Benign Tumors. Benign tumors such as fibromas, cysts and osteomas are usually slow growing and readily identified by biopsy.

Specific Infections. The most important of the specific infections are tuberculosis, syphilis, lupus and yaws. Their presence can be established by the serology and pathology.

Neuralgia or Tic Douloureux. Neuralgia or tic douloureux may be simulated after the tumor has eroded the bony walls of the antrum with tumefaction of soft parts and resultant pain. Lack of response to specific therapy should differentiate the neoplasm.

Blood Dyscrasias. When epistaxis occurs blood dyscrasias must be considered if no local cause is obvious. A case from the author's private practice is mentioned in which malignancy was first suspected in a man 47 years of age, who had repeated hemorrhages from the nose only. These were of such severity as to require periodic transfusions. A diagnosis of thrombocytopenic purpura was established from the blood picture.

Therapy. Certain general and local supportive measures preliminary to the actual attack on the growth are essential. Blood chemistry levels and serology should be checked. Transfusions with whole blood as determined by the complete blood count and hemoglobin are indicated. Locally, the problem of dental hygiene is a complicating factor in convalescence. Acute infection, local or general, must be eradicated before proceeding. In many cases the general condition of the patient remains good up to a late date. In the series reported this, unfortunately, was not the rule. Some of these patients were cachectic or suffering from intercurrent disease when first seen.

Radiation alone or combined with surgery are the most universally accepted forms of treatment of the growth (Del Regato,¹⁰ Watson¹⁴). The combination of the two is the more generally favored. Radiation may be by deep x-ray or radium "needles" or "seeds". With radium, Lucas³⁷ states that five threshold skin erythema doses are sufficient to destroy the radiosensitive carcinomas of the antral mucosa. Seven to ten threshold skin erythema doses are required for other types of carcinoma of the antrum. Radium implanted in the cavity for 2000 mg. hours is sufficient to deliver seven threshold skin erythema doses across the greatest area of the antrum. However, x-ray therapy, using the divided dose method with 200 KV high filtration, 50-60 cm. skin-target distance, and a small port "has far more to offer than radium" in the treatment of carcinoma of the antrum.

Roentgen radiation preoperatively as well as postoperatively is advocated (Ringertz²⁰, Öhmgren¹⁶).

Surgery may be one of two types: the "cold knife" or electro-surgery. The latter by means of the electrocoagulating current is of value in bleeding and in sealing off lymphatic drainage in the area of the growth. The actual surgical approach may be intranasal through a wide antrotomy, a Caldwell-Luc approach, or an external Mourié operation.

The choice of procedure will, in the end, be governed by the condition of the patient. Conservatism has no place in the treatment of this condition. Teeth may have to be sacrificed in the surgical approach. Enucleation of the eye may be necessary as a result of actual involvement by the growth, the extent of the surgery, or destruction by radiation (degenerative changes and vessel thrombosis in the orbit). External irradiation is sometimes sufficient to destroy

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the growth without surgery (Robinson³⁸). It is applicable chiefly to the anaplastic carcinoma which is radiosensitive. Its value in the well differentiated epithelioma or squamous cell carcinoma with pearl formation, which is radio resistant, is questionable.

Prognosis. The prognosis is bad. If the diagnosis can be made easily, the growth has already become extensive. The median life expectancy of patients with treated carcinoma of the antrum is only 17 months (Welch and Nathanson³⁹).

In the series of 9 cases reported, the average length of life after coming under observation for carcinoma of the antrum was 5.7 months. One patient was living and well when last located, seven years and two months since he first came under observation.

The location or site of the tumor is a factor in the prognosis. Snitman⁴⁰ distinguishes between carcinomas in the suprastructure and infrastructure of the antrum as defined by Öhmgren.¹⁰ A line drawn from the inner canthus of the eye to the angle of the jaw divides the two. Carcinomas in the plane above this line of the suprastructure situated medially are often associated with nasal polypi and are more apt to invade the meninges and tend to early lymph gland involvement. Carcinomas in the lateral part of the suprastructure are more dormant at onset until they invade the malar bone and produce the characteristic tumefaction of the external angle of the orbital floor. Carcinomas in the infrastructure cause the earlier symptoms referred to the teeth. Evaluation, where possible under this system, of the location of the lesion is an aid to the prognosis. However, many cases when first seen are beyond the stage where an accurate appraisal of the site of origin is possible.

Histological appearance of the tumor has some bearing. The more anaplastic the growth, the more rapid its progress.

Another important factor is the presence or absence of regional lymph node extension. It has been established that the cervical chains act as protective barriers against the spread of cancer cells.

Causes of Death. Carcinoma itself accounts for many of the deaths. Percy,¹³ in a series of 50 cases in which eleven were living at the time of the writing, quotes 9 as having died from causes other than the cancer. Ringertz,²⁰ in a series of 26 treated cases in which seventeen had died, quotes 4 as having died from causes other than the carcinoma of the antrum. In the series of cases reported, the cause of death was the tumor itself in five cases. Intercurrent debili-

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tating diseases were present in at least three cases. In the private case reported, the immediate cause of death was basal meningitis.

Malignant cachexia and septic absorption are probably the chief causes of death. Pneumonia, resulting from these, is the direct cause. Death from pulmonary complications are more frequent with removal of the palate as the nose and mouth then become one continuous cavity.

Shock from the extent of surgery and blood destruction from irradiation are added factors in fatalities.

SUMMARY

1. Nine cases of carcinoma of the antrum are presented and literature of a ten-year period, from 1935 to 1946 inclusive, is reviewed.
2. The most common type of antral cancer is the squamous carcinoma. The transitional, the columnar, the adenoides cysticum and the adenocarcinoma are less common.
3. The etiology is still a matter of controversy.
4. The most common age incidence is 50-60 years for males and 60-70 years for females. Males are more susceptible than females.
5. The signs and symptoms which should suggest antral carcinoma are unilateral discharge, nasal obstruction, epistaxis, ulceration of the hard palate, paresthesia or anesthesia of the face, lacrimation, pain, malar prominence, exophthalmos and diplopia.
6. The differential diagnosis must be made from chronic sinusitis, polypi, osteomyelitis, secondary malignancy, benign tumors, specific infections, neuralgia or tic douloureux, and blood dyscrasias.
7. The prognosis is poor but is governed somewhat by the site of origin, the extent of involvement and the cytological type of the tumor.
8. The therapy is surgery combined with radiation. Radiation may be used preoperatively or postoperatively, but both are desirable. A radiosensitive tumor rarely needs only external radiation.

I wish to express my appreciation to Dr. James Lisa of the Department of Pathology of the New York City Hospital for his valuable assistance in the preparation of the pathological material incorporated in this paper.

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XV

PENICILLIN AEROSOL THERAPY IN SINUSITIS

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This study was undertaken to determine the value of penicillin aerosol therapy in sinusitis.

Before beginning any discussion of penicillin aerosol treatment, one fact is to be remembered: chemotherapy in any form, whether it be sulfonamides, penicillin, streptomycin or any other, is not to be used without due regard to the principles of good medicine and surgery. Regardless of the particular branch of medicine involved, operation when indicated is still indicated; pus that has to be drained still has to be drained. As applied directly to otolaryngology, chemotherapy in any form is no cure-all and good otolaryngological diagnosis and treatment are still in order. However, we hope to prove that penicillin aerosol has a place in the treatment of sinusitis.

The aerosol technique was developed in an attempt to bring the penicillin into closer contact with the actual infecting organisms. The hoped-for antibiotic effect depends on the entrance of the nebulin in sufficient concentration to result in bacteriostasis and on the presence of penicillin-sensitive organisms in the sinuses. Blood concentrations of from 0.01-0.18 units per cc. have been reported following inhalation of from 20,000-70,000 units.

The apparatus used is that of Barach.⁴ It consists essentially of two nose pieces, a positive and negative pressure valve, a rebreathing bag, nebulizer and Venturi tube. Negative pressure is obtained by throwing the switch on the valve so that oxygen passes through the Venturi tube. The technique consists of having the patient take three or four breaths of the penicillin vapor, followed by suction (60 mm. of mercury), alternating in this way until the penicillin is entirely vaporized. A small amount of saline is then added to obtain as much of the penicillin left in the apparatus as possible. The prin-

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ciple involved is to obtain a negative pressure in the sinuses so that the aerosol will enter when inhaled under slight pressure.

Because of time limitations, patients were treated once daily with 40,000 units of penicillin. Each patient had a complete physical and x-ray examination and blood count. Cultures were taken at the start and finish of treatment and in many cases at several times in between. Local treatment consisted of making sure that the sinus openings were clear and available. This was accomplished by shrinkage and occasional suction irrigation. Treatment was kept at a minimum to avoid a confusion of issues.

In 1940, nebulization rather than inhalation therapy of bronchial asthma using epinephrine 1:100 was suggested by Abramson.¹ Noting Dawson's observation⁸ that penicillin was bacteriostatic in extremely high dilutions, inhibiting the growth of streptococci in quantities as low as 0.03 micrograms per cc., Bryson, Sansone and Laskin⁹ suggested aerolization of penicillin. In experiments on rabbits, they proved that penicillin aerosol was absorbed into the lungs and excreted into the urine. This led to the assumption that the penicillin was absorbed into the blood stream. In his 1945 course before the American College of Allergists, Barach¹⁰ discussed the inhalation treatment of bronchial asthma. Penicillin aerosol was successfully used in infectious cases due to streptococcus or pneumococcus in concentrations of 20,000-50,000 units per cc. Higher concentrations caused allergic reactions. Hagens, Karp and Farmer¹² arbitrarily chose 8,000 units per cc. for the treatment of bronchiectasis and pneumonia, using 16 treatments daily, and noted improvement in most acute cases and temporary improvement in chronic cases. Blood and urine levels were determined in most patients.

In January 1946, Alvin Barach and his associates¹ first reported on the treatment of infection of the nasal accessory sinuses with penicillin aerosol. Barach developed an apparatus for the production of penicillin aerosol with intermittent negative pressure in the nasal cavity and nasopharynx. This was obtained by using a Venturi tube connected to a positive and negative valve. With a flow of seven to ten liters of oxygen per minute, a negative pressure of 11-18 cm. of mercury was produced. In hospitalized patients, he used 40,000 units in 2 cc. of saline four times daily. In office practice, 50,000 units in 2.5 cc. of saline once daily was used. He presented one case of chronic sinusitis with improvement demonstrated by x-ray films.

Several others, Vermilye,¹⁸ Abramson,² and Sulman,¹⁵ reported on the treatment of acute and chronic sinusitis with good results.

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Barach and his associates⁵ reported on 47 patients treated with penicillin aerosol and demonstrated improvement by x-ray films and culture in a number of these.

McAuliffe,¹³ Prigal,¹⁴ Finke,⁹ Davis,⁷ Fishman and Gelehrter¹⁰ and Hagens¹¹ reported on different apparatus developed for the production of the aerosol and pointed out the ease and safety of its use in acute and chronic sinusitis and pulmonary infections in both hospital and office practices.

It is interesting to note that all those who have used penicillin aerosol therapy for respiratory infections involving the paranasal sinuses, larynx and lungs have uniformly reported good results. In addition, the literature stresses the ease of administration and comparative lack of allergic reactions.

One year ago at this time we reported the results of the first 104 cases.¹⁷ It was felt that those patients should be followed through a full winter to further evaluate our results. Each patient was asked to return for a complete check-up, including x-ray films and culture. In addition, 108 new patients were treated.

To recapitulate, patients were classified as "slight", "moderate", and "severe", depending on clinical findings, duration of infection and x-ray examination. Results were tabulated as "clinical cure", "marked relief", "moderate relief", "slight relief" and "no improvement". Those who were classified as clinical cures had complete relief of symptoms and a negative nose on examination. The other classifications are self explanatory.

Of the cases treated, 22 were slight, 65 were moderate and 17 were severe. There was no improvement in 14, slight improvement in 11, moderate improvement in 33, marked improvement in 17, and clinical cures in 23. Of the clinical cures, 8 were slight originally, 14 moderate and 1 severe. Of the cases with marked improvement, 3 were slight, 11 moderate and 3 severe. The average number of treatments per patient of the original 104 cases was 12.

Of the original 104 cases, 37 did not return for recheck. Of the remaining 67, 17 showed at least some improvement on x-ray examination. One patient showed increased involvement; he had had a cold with acute exacerbation of his sinusitis at the time the x-ray was taken. The others showed no change on x-ray examination.

Of the 17 who showed improvement 4 had been classified as clinical cures, 3 as marked improvement, 4 as moderate improvement, 3 as slight improvement and 1 had not completed treatment as advised, discontinuing after eight aerosol treatments.

In all, there were six allergic reactions, consisting of rash and headache. The average number of treatments for all 212 patients was 10.6.

Above all, we were interested in following those patients who had been treated through another winter in order to record any recurrences of their previous infections. All were asked to return for further observation and treatment if there were any recurrence.

Nineteen patients reported recurrence of symptoms. These are listed below. (The numbers given correspond with the case numbers on our charts*). The type of recurrence is given with the previous diagnosis, claimed result and number of treatments.

No. 1. Has had asthmatic attacks. Chronic sinusitis and allergy, moderate involvement, one year's duration: moderate improvement: 17 treatments.

No. 4. Occasional nasal congestion. Chronic sinusitis, moderate involvement, one year's duration: moderate improvement: 11 treatments.

No. 8. No change, temporary relief. Chronic sinusitis, moderate involvement for years: temporary improvement: 23 treatments.

No. 10. Had recurrence of symptoms. Got complete relief from antistine. Chronic sinusitis, allergic rhinitis, chronic laryngitis, severe for years: moderate improvement: 22 treatments.

No. 12. Occasional nasal congestion but never as bad as before. Chronic sinusitis, moderate, one year's duration: moderate improvement: 6 treatments.

No. 17. Occasional hoarseness. Chronic sinusitis, bronchitis, mild, six months' duration: clinical cure: 9 treatments.

No. 20. One recurrence. Chronic sinusitis, allergy, severe involvement for years: marked improvement: 19 treatments.

*The protocol charts are available from the author upon request.

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No. 33. Recurrence of hoarseness and nasal congestion. Chronic sinusitis, laryngitis, mild, six months' duration: clinical cure: 8 treatments.

No. 35. One recurrence. Chronic sinusitis, allergy, ten years' duration, moderate involvement: moderate improvement: 29 treatments.

No. 42. Had one cold. Chronic sinusitis for years, moderate involvement: moderate improvement: 17 treatments.

No. 53. Had one cold. Chronic sinusitis, severe involvement for years: moderate improvement: 20 treatments.

No. 57. Marked improvement but constant recurrence, none after autogenous vaccine administered. Chronic sinusitis, moderate, two months' duration: 29 treatments.

No. 78. Had one cold. Chronic rhinitis, allergy, slight for years: clinical cure: 6 treatments.

No. 79. Recurrence of headaches after two months. Chronic sinusitis, slight, two months' duration: moderate improvement: 9 treatments.

No. 87. Had one cold. Chronic sinusitis, severe involvement, 15 years' duration: marked improvement: 21 treatments.

No. 91. Had one cold. Chronic sinusitis, mild, two months' duration: moderate improvement: 21 treatments.

No. 92. Frequent recurrences. Chronic sinusitis, allergy, severe. Has had several ethmoidectomies, two bilateral Caldwell-Lucs. 38 treatments: improvement on each occasion.

No. 97. One recurrence. Chronic sinusitis, slight for years: marked improvement: 33 treatments.

No. 99. Two recurrences. Chronic sinusitis, moderate, two years' duration: moderate improvement: 26 treatments. No recurrence after autogenous vaccine.

In citing these cases of recurrence, I am not trying to make any claims for or against penicillin aerosol treatment in preference to

any other. As a matter of fact, I do not believe that these patients represent failures. Other than the one patient who stated that recurrence of his symptoms was relieved by antistine (case No. 10), these people returned to the clinic seeking more treatments since they had made the rounds of outside physicians and other clinics without relief comparable to that obtained from the penicillin aerosol. On the other hand, 37 patients did not return for recheck and x-ray films without charge. Undoubtedly many or most of these were disappointed in the results they obtained.

Altogether, 212 patients were treated. Of these, 58 were classified as clinical cures, 34 as marked improvement, 45 as moderate improvement, 19 as slight improvement and 34 as no improvement.

Of those classified as clinical cures, 15 had been slight, 37 moderate, and 6 severe; as marked improvement, 3 had been slight, 23 moderate, and 8 severe; as moderate improvement, 6 were slight, 28 moderate, and 11 severe; as slight improvement, 5 were slight, 10 moderate, and 4 severe; as no improvement, 5 were slight, 15 moderate, and 14 severe.

Twenty-one patients started treatment but did not return, mostly because of business or school commitments. Three had had several previous polypectomies, three were obvious psychoneurotics, one had atrophic rhinitis and one had a recently acquired four-plus Wassermann. These patients were refused treatment after the original examination. There was also one patient referred because of chronic cough who proved to have tuberculous cavities in both upper lobes.

The 17 patients who showed improvement on x-ray examination when rechecked are listed below. The numbers, again, are the same as those on our charts. The diagnosis, involvement and duration, classification as to result of treatment, number of treatments, otolaryngological treatment and claimed result are given.

No. 7. Allergic rhinitis for years, severe involvement: 8 treatments, shrinkage: treatments not continued as advised: not classified. Moderate clearing of left antrum.

No. 23. Acute exacerbation of chronic sinusitis, two days, recurrent, moderate involvement: 7 treatments, antrum irrigation: clinical cure: some clearing of all sinuses.

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No. 29. Chronic sinusitis, moderate, ten years' duration: no local treatment given: 11 aerosol treatments: clinical cure: some clearing of all sinuses.

No. 46. Chronic sinusitis, moderate involvement, one year's duration: 26 treatments, suction irrigation: marked improvement: some clearing of ethmoids and left antrum.

No. 55. Chronic sinusitis, moderate, two years' duration: 15 aerosol treatments, nothing locally: clinical cure: clearing of all the sinuses.

No. 59. Chronic sinusitis, moderate involvement for six years: 11 treatments, suction irrigation: clinical cure: some clearing of all sinuses.

No. 60. Chronic sinusitis, moderate for one year: 9 treatments, suction irrigation, pyribenzamine (50 mg. three times a day): slight improvement: slight clearing of all sinuses.

No. 68. Chronic sinusitis, atrophic rhinitis, moderate involvement for years: 14 treatments, suction irrigation: moderate improvement: slight clearing of all the sinuses.

No. 69. Chronic sinusitis, moderate for one year: 13 treatments plus suction irrigation: marked improvement: clearing of all the sinuses.

No. 87. Chronic sinusitis, severe for 15 years: 21 treatments, suction irrigation: marked improvement: slight clearing of all the sinuses.

No. 90. Allergic rhinitis, moderate for two years: no local treatment: 21 aerosol treatments: slight improvement at first, marked improvement later: moderate clearing of all the sinuses.

No. 93. Chronic sinusitis, moderate for years: 11 treatments, suction irrigation: moderate improvement: clearing of all the sinuses.

No. 96. Chronic sinusitis, moderate involvement for years: 9 treatments, with nothing locally: moderate improvement: some clearing of all the sinuses.

No. 99. Chronic sinusitis, moderate involvement for two years: 26 treatments, suction irrigation: moderate improvement: clearing of all the sinuses.

No. 101. Chronic sinusitis, moderate involvement, one year's duration: 5 aerosol treatments, nothing locally: slight improvement: some clearing of all the sinuses.

No. 112. Chronic sinusitis, moderate for six years: 14 treatments after argyrol packs: moderate improvement: some clearing of all the sinuses.

In general, our bacteriological results have confirmed those of other investigators. For the most part, patients continued to show the same type of bacteria before, during and after treatment, regardless of the results obtained clinically. For example, many varied from a hemolytic *Staphylococcus albus* to a nonhemolytic form on several cultures, but continued to show the *Staphylococcus albus*. There were a few shifts to gram-negative bacilli from gram-positive cocci but these were in the minority.

We were able to obtain good blood levels (0.24 units per cc.) in only two of seven patients in whom determinations were made. We have no explanation for this since other workers have obtained high levels in most of their patients.

In five cases, an antrum irrigation was performed after penicillin aerosol treatment. In two of these, penicillin was obtained in the washings in measurable amounts. Barach⁴ was fortunate in having two patients with oro-antral fistulae. In these he was able to obtain only a small amount of penicillin after aerosol treatment. After direct instillation of 5,000 units in 5 cc. of saline, only 376 units were recovered in twenty minutes. This can be explained by the fact that the penicillin was absorbed or that some was clinging to the mucous membrane.

It must be remembered that statistics of any sort may be interpreted to obtain almost any desired result. For about three years I have been using penicillin aerosol as an adjuvant to the usually accepted otolaryngological therapy. In properly accepted cases, penicillin aerosol (with oxygen) is a valuable addition to our armamentarium. I particularly mention oxygen since it has been used in all of our treatments. In acute infections with involvement of the mucous membranes of the nose, nasal accessory sinuses, nasopharynx, pharynx, hypopharynx and the laryngotracheobronchial tree, aeration plays an important part. Oxygen alone may inhibit the growth of secondary invaders. Penicillin aerosol with oxygen is, in my opinion, the treatment of choice, provided there is not an empyema of the

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antrum, sphenoid, frontal or individual ethmoid cell. To recapitulate, pus, if present, must be drained. Once under control by drainage and provided the proper penicillin-sensitive organism is present penicillin aerosol may shorten the duration of treatment.

CONCLUSIONS

As to the practical application of penicillin aerosol therapy in otolaryngology, I should like to list the following:

1. Allergic rhinitis: Treatment is contra-indicated except in a proven case of bacterial allergy (bacteria sensitive to penicillin) or unless the case is complicated by sinusitis in addition to allergy.
2. Acute rhinitis (common cold): Results obtained are purely due to local treatment and general medical care plus oxygen.
3. Acute sinusitis (with or without any complications in the upper or lower respiratory tract): Results are entirely dependent on the presence or absence of inspissated pus in any of the sinus cavities or in a chronic bronchiectatic cavity.
4. Sinusitis in children: Because of lack of pain and ease of administration, penicillin aerosol with proper administration of local therapy usually obtains spectacular results. Shrinkage may be obtained by simple nasal spray and the nose may be cleared by direct suction. One case is presented on our charts (No. 98) in which local treatment, in addition to penicillin aerosol, did not produce improvement. Original culture showed hemolytic *Staphylococcus aureus*. The history, eventually obtained after several treatments without results, revealed a deserted mother trying to support her six-year-old child in a damp one-room basement apartment. Because of lack of improvement, repeated cultures were taken. After several treatments the *staphylococcus* disappeared and the infection present proved to be due to *Escherichia coli*. Streptomycin (500 mg.) was used in the aerosol both in addition to penicillin and alone. No improvement was obtained until an autogenous vaccine was made. Under the accepted regime of treatment with vaccine, this child became asymptomatic.

A number of our very young patients have been treated with penicillin aerosol. Most of these had been treated previously for "sinus", and had had tonsillectomy and/or adenoidectomy. Many had had a few (2-10) tests for "allergy". Outside of two entirely uncooperative children, in addition to the one mentioned above, every

one showed marked improvement with occasional recurrence. Those who had recurrences were treated with autogenous vaccine and have not had reinfections since.

5. Acute exacerbation of chronic sinusitis: Many cases of chronic sinusitis are for years asymptomatic except for occasional nasal congestion, discharge or postnasal "drip". Acute flare-ups may be controlled by aerosol therapy. When accompanied by oxygen, very often the chronic infection subsides. There have been a number of these patients who have had complete relief from recurrences due to administration of autogenous vaccine in addition to aerosol therapy.

6. Chronic sinusitis: Occasionally, spectacular results may be obtained. Chronic patients have been advised that no relief other than that from acute exacerbation is to be expected. In order to inaugurate this program, a number of chronically infected patients were accepted for treatment. There were a few who obtained almost miraculous relief. These may be classified as having either undiagnosed bacterial allergy or anaerobic bacterial infection. Undoubtedly the results obtained in these cases were entirely due to oxygen therapy.

7. This study was supposedly limited to sinusitis but, because of the results obtained, a number of patients, nurses, attendants and employees of the hospital (who are not included in our charts) have been treated for other infections, especially acute laryngitis and acute bronchitis. Results obtained indicate that penicillin aerosol therapy with oxygen has given spectacular relief in almost every case.

8. Psychoneurosis: A number of patients who were obviously psychoneurotic were referred for treatment. An attempt was made to accept these mentally diseased patients at first and after the so-called psychosomatic approach, treatment was instituted. There was not one patient who obtained relief. Penicillin aerosol with oxygen or saline solution with oxygen and supposedly impressive apparatus in addition to the psychosomatic approach, produced entirely negative results. There were a few patients of this type who demanded further treatment. Because of entirely negative results, as determined by local examination, all were refused.

I should like to thank Dr. Fred Graef, Mr. Fred Heffinger, and Mrs. Mildred Reed for their kind assistance.

121 EAST 60TH STREET.

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XVI

NASOALVEOLAR CYSTS

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As Rosenberger¹ has indicated, nasoalveolar cysts have been definitely neglected in the American rhinologic literature. Although the first case was reported in 1882 by Zuckerkandl², one must turn to the American dental literature³ and certain recent texts on oral pathology^{4,5} for an adequate discussion of the condition. Only pertinent texts in otorhinolaryngology refer to it. Possibly part of the reason for the paucity of knowledge regarding the subject (among otolaryngologists) is the belief that any cystic mass in this vicinity is of dental origin. A further influencing factor is the relative scarcity of the condition. To date only 82 cases have been reported in the literature. Three additional cases will be discussed here.

Nasoalveolar cysts are always found at the attachment of the alae of the nares. As they increase in size, they encroach on the nasal vestibule and cause a swelling in the floor of the nose, often elevating the anterior tip of the inferior turbinate and obliterating the nasofacial fold of the involved side. Bilateral cysts have been reported only once. As the growth progresses the swelling may be demonstrated at the gingivolabial junction. If the cyst becomes sufficiently large there may be a definite swelling over the maxillary sinus which extends upward toward the orbital rim of the maxilla. On palpation, the cyst is fairly fluctuant and partially movable.

The patient usually complains of unilateral nasal obstruction, or a swelling which is causing an embarrassing facial deformity. He seldom remarks about pain over the mass, despite the fact that the cysts are frequently secondarily infected. Only three cases have been reported in men.⁶

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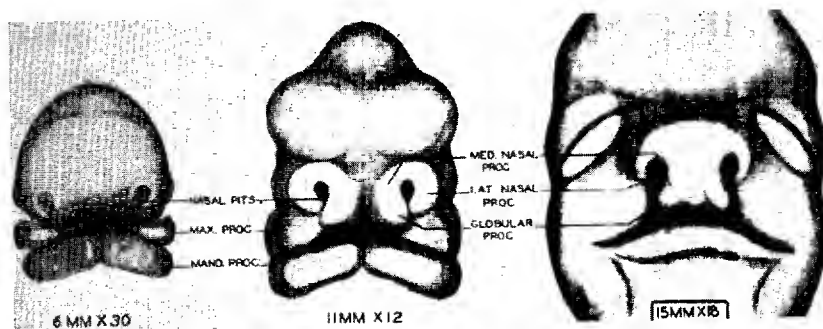


Fig. 1.—Embryological development of nasoalveolar cysts. (Courtesy of Dr. F. A. Sooy — Modified after Peter & Fischel.)

The information secured by roentgenograms is not positive. There is seldom enough change to afford the roentgenologist a diagnosis. The importance of this feature will be discussed under the general heading of differential diagnosis. However, the cyst can be aptly demonstrated by the injection of radiopaque oil as demonstrated by Laszlo.

The treatment advocated is surgical excision. During the process of removal it has been observed that these cysts firmly adhere to a shallow groove in the maxilla at the point of attachment of the ala of the nostril. Difficulty is therefore encountered in the attempt to remove the entire cyst and it is usually ruptured during the act of separation.

Embryology: The theory of Peter,⁶ substantiated by the work of Klestadt,⁷ suggests that nasoalveolar cysts are of developmental origin. This opinion has been generally accepted among the later works, although several other theories have been propounded. The accepted one considers the cyst to have been formed from ectodermal rests at the site of origin of the maxilla and premaxilla, which in turn have been formed from the maxillary and globular processes of the embryo (Fig. 1).

Histopathology: The cyst has an epitheliated connective tissue sac, and usually contains a thick mucoïd fluid which may be clear, straw-colored, or occasionally brownish.

Schroff³ stated that the wall encountered consisted of a connective tissue layer covered with epithelium. The epithelial layer contained two rows of cylindrical cells with a few goblet cells. The connective tissue layer was thicker. There was no round cell infiltration and no existing glands or ducts. Thoma⁸ agreed with this opinion except that he found a great abundance of goblet cells in all stages of secretion.

Conversely, Rosenberger¹ found the epithelium to be stratified and varying from two to ten cells in thickness. Where the epithelium was thin the cells were flattened, and where it was thicker they tended to be polygonal. In some areas, polymorphonuclear leukocytes were found infiltrating the epithelium, and the cyst wall consisted of dense fibrous connective tissue. All sections showed a decided degree of chronic inflammation characterized by a severe focal infiltration of the stroma with plasma cells, lymphocytes and a few polymorphonuclear leukocytes.

Huizinga⁹ observed still another variation. In two of his cases the epithelium was of the high columnar type. Cilia were visible in some areas under the highest magnification. The cilia rested on a flattened layer of basement cells. In Huizinga's other case, the cells were somewhat cuboidal in shape or squamous, and in some areas the basement cells were columnar, but such areas were lacking in cilia. In our opinion the differences were due to varied pressure on the cyst wall. The microscopic findings of Laszlo¹⁰ and Sooy¹¹ support this view.

Differential Diagnosis: The nasoalveolar cysts must be differentiated from other cysts of fissural origin as well as those of dental origin in order to clarify the diagnosis.

Other fissural or facial cleft cysts are:

A. Median Cysts. Median cysts are central cysts which form in the the median fissure of either the maxilla or the mandible. There are two types of median maxillary cysts:

(1) Median alveolar cysts are probably formed from epithelium derived from the dental lamina which forms in the fissure between the roots of the first two incisors, according to Thoma. The teeth may be normal in every way except that they are slanted due to the pressure exerted by the expanding cyst. The resistance offered by the teeth causes these cysts to have an elliptical shape. This

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is recognized by the fact that the cysts take on a rounded shape when seen in edentulous people.

(2) Median palatal cysts occur again in the line of the median fissure, but are found farther back on the hard palate. They must not be mistaken for incisive canal cysts. Roentgenograms are of great aid in diagnosis. The median cysts are differentiated from the incisive canal cysts by their location. Histopathology shows a connective tissue sac which contains a layer of collagen fibers, usually thick, lined by squamous type of epithelium.

B. Globulomaxillary Cysts. These cysts form at the junction of the globular and maxillary processes. They may easily be mistaken for radicular cysts, particularly in the case involving dental caries. However, the greatest differential point is occurrence of the globulomaxillary cyst between the roots of the lateral incisor and the canine which, as in the case of the median alveolar cyst, causes divergence of these teeth.

C. Nasopalatine Cysts. These cysts may be of two types: completely encapsulated in bone or lying under the papilla palatina in the incisive foramen. As the name would infer, they are both cysts of the incisive canal.

Pathogenesis: Thoma⁸ quotes Peter⁶ as saying that the ducts usually become obliterated at one end or the other by either nasal or oral epithelium, forming a blind cul-de-sac. He further quotes Rawengel¹² (1923) as having demonstrated three types of epithelial tissue in the incisive canal from which cysts might be derived: the nasopalatine duct or its remnants, a middle epithelial cord, and epithelial rests in the most posterior part of the papilla palatina. Trauma of any sort may be an etiological factor in the formation of these cysts.

(1) Incisive Canal Cyst. There is little evidence of the presence of the cyst aside from the fact that the patient may notice a discharge from time to time. This is usually described as having a salty taste. The patient may be able to draw out the discharge although he seldom complains of pain.

X-ray films are of great help in diagnosing these cysts, inasmuch as there are no roentgenographic changes on the cyst of the papilla palatina; therefore it is important for differential diagnosis between the two types.

Histopathology: The cysts contain a thick membrane which is made up of connective tissue. The epithelium of the lumen varies in type from squamous to cubic to ciliated columnar. The ciliated columnar epithelium is found in cysts derived from a cord extending down from the nasal cavity. The squamous or cubic type exists in cysts arising near the oral end of the incisive canal. There may be severe inflammatory changes in the capsule.

(2) Cyst of Papilla Palatina. This cyst was first described by Thoma in 1936. He states that it is derived from the epithelial contents of the incisive foramen rather than from the incisive canal. It forms a rounded swelling in the vicinity of the papilla palatina, since it is not completely surrounded by bone. Sufficient pressure will cause the cyst's contents to exude into the mouth, and again the patient is aware of a salty taste.

The treatment for both of the above conditions is surgical removal of the sac.

D. Dental Root Cyst. Dental root or radicular cysts present a cystic lesion found about the apex of any tooth root as a result of an apical granuloma. This type is filled with pus or necrotic debris. It has a thick submucosa consisting of collagenous fibers and is lined with squamous epithelium.

X-ray films are of great aid in differential diagnosis. They show radiolucency around the apex of the tooth root, and the position of the surrounding teeth is seldom disturbed in contradistinction to the x-ray findings of the median alveolar and the globulomaxillary cysts.

Treatment is extraction of the affected tooth and removal of the cyst lining, usually by curettage.

E. Dentigerous Cyst. These are slowly enlarging cysts derived from anomalous tooth development. They are readily differentiated because they include the crown of a tooth or an anomalous tooth within the cystic space, which is lined by pavement epithelium.

According to Roper-Hall¹³ supernumerary teeth often become cystic, and he observed that two out of three supernumerary teeth occurred in the lateral incisor-canine area. Roentgenograms are of

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diagnostic value. They show a large radiolucent area in the bone containing either a crown or an anomalous tooth. Pain is rarely present without secondary infection.

Treatment consists of surgical removal of the cyst as well as the lining epithelium.

It should be mentioned also that dermoid cysts may occur in this region. However, these are usually cysts of the midline and are due to the inclusion of ectoderm in the mesoderm at the time of closure of the embryonic fissures. They usually contain hair follicles, sweat glands, teeth, and a secretion of semisolid consistency.

Only one other condition might be confused with nasoalveolar cyst: an adamantinoma or adamantoblastoma. A cystic type of tumor, or a cystic and solid type of tumor, this variety is most often multilocular (81.7% according to Thoma). However, if it is unilocular, it may be confused with dentigerous cyst on roentgen examination because it, too, frequently contains the crown of a tooth. These tumors may be caused by trauma. They are usually extensive and rather rapid in growth. They more frequently affect the mandible than the maxilla in a ratio of 83.7 to 16.3, according to Thoma.

REPORT OF CASES

CASE 1.—On August 10, 1945, a white woman aged 46 was admitted to the clinic with the complaint of a growth of the right side of the nose, which had been present about two months.

Examination revealed a small rounded, hard, firmly fixed mass in the right nasal vestibule, which was producing partial nasal obstruction and partial obliteration of the nasofacial fold.

Dental consultation was obtained three days later, and the impression was a chronic alveolar abscess.

She was again examined on September 10, 1945, after all the upper teeth had been extracted, and the swelling appeared to have decreased slightly.

Examination on August 22, 1946, revealed that the mass in the right nostril had not changed since the first examination. It was the



Fig. 2.—Deformity produced by nasoalveolar cyst.

opinion of the dental consultants that the diagnosis was most likely to be globulomaxillary cyst, although x-ray examination showed no involvement of bone.

On October 8, 1946, the patient underwent an operation under sodium pentothal anesthesia, augmented by novocaine and adrenaline to control bleeding. The initial incision was made in the gingivolabial fold near the midline, as in a Caldwell-Luc operation. The cyst was exposed, and basically by blunt dissection separated from the surrounding tissues. The cyst was ruptured at its inferior margin during removal, where it was firmly attached by fibrous connective tissue to a groove in the maxilla. The cavity was dusted with sulfa powder, and the mucous membrane closed loosely with three silk sutures which were removed four days later. The postoperative course was uneventful and the patient was discharged from the hospital after suture removal.

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Pathologic Report: The specimen consisted of a cyst from the region of the nasolabial fold. There was a flattened, ovoid mass, 0.8 cm. in diameter and 0.3 cm. in thickness. On one surface a grayish pink thin cyst wall was evident, surrounded by soft, pink, blood-stained tissue. The lumen was empty and the inner surface pink and glistening. Microscopically the cyst was found to be lined with stratified squamous epithelium forming a thin layer and showing several patches of erosion. A wall of dense connective tissue contained fairly large patches of lymphocyte and plasma cell infiltration.

Diagnosis: Nasoalveolar cyst with chronic inflammation of the wall.

CASE 2.—On June 5, 1947, a white woman aged 28 was examined in the Department of Medicine. The diagnosis was: (1) tension state with tension headache, and (2) rheumatic state. She was referred to the Ear, Nose and Throat Department because of the presence of a mass lateral to the right side of the nose (Fig. 2).

The patient was observed in the Ear, Nose and Throat Department on June 6, 1947, where she complained of a swelling of the right side of the nose of two months' duration. She stated that her husband had called her attention to the swelling two months previously and had noticed its existence at intervals. The swelling was not tender and there was no pain over the site. Mild right nasal obstruction had been observed and in addition she described the unrelated symptoms of otorrhea in childhood, intermittent tinnitus and "black outs" brought on by nervousness or excitement and relieved by closing the eyes. Examination revealed a mass in the right side of the external naris, anterior to the bony structures, extending into the vestibule of the nose and encroaching on the anterior tip of the inferior turbinate. The mass had a granular appearance. It was fluctuant, and soft on palpation. Surgical removal was advised at the time. X-ray examination showed normal paranasal sinuses.

On March 1, 1948, the patient was admitted to the hospital. She stated that the mass had changed size several times since she was last seen, but it had never completely disappeared. During the week previous, the swelling had been so great that the right nostril was completely occluded, and the right lower eyelid was puffy.



Fig. 3.—*a*, Deformity produced by nasoalveolar cyst; *b*, Exposure of nasoalveolar cyst by modified Caldwell-Luc incision.

Upon examination the swelling was found to extend over most of the superior maxilla. The right naris was partially occluded in the area of the vestibule and complete obliteration of the nasofacial fold was noted. The mass was palpable and ballotable beneath the upper lip at the upper end of the nasolabial fold.

On March 2, 1948, the cyst was removed under sodium pentothal anesthesia, using novocaine with adrenaline as an adjunct to control bleeding. A medial gingivolabial incision was made similar to that performed in a Caldwell-Luc operation. Mainly by blunt dissection, the sac was removed. As the inferior surface was approached in removal, the sac was ruptured and a relatively thin serous fluid exuded. A culture of this fluid was taken which showed *Staphylococcus albus*. The inferior surface of the sac was firmly attached to a groove in the bone. The mucous membrane was approximated with six black silk sutures. No drain was inserted. On March 4, 1948, the patient was discharged from the hospital and two days later she returned for suture removal. The swelling had almost gone. Later communication revealed that the patient was entirely symptom free (Fig. 3).

Pathologic Report.—The specimen consisted of a spherical, thin-walled cyst, measuring 2 cm. in diameter. The color of this mass

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varied from reddish tan to pinkish white. There was a small tear in the wall measuring 2 cm. in diameter. The contents had escaped. The inner wall of this mass appeared smooth, pink and glistening. Microscopically the cyst wall was found to be formed by connective tissue, in part hyalinized and with fresh hemorrhage, and lined by an epithelium, in part single layered, at times with a few areas of stratified epithelium, and at times either cuboidal or low columnar. Scattered lymphocytes and a few plasma cells were present in the wall.

Diagnosis: Simple cyst (nasoalveolar) with chronic inflammation.

CASE 3.—On January 24, 1948, a negress aged 36 was observed in the Ear, Nose and Throat Department. Her chief complaint was a mass in the left nostril, which had been present for about one year. About two and a half years previous to admission she became aware of a gradually increasing swelling of the left side of the face, beginning in the region now involved and spreading over the left antrum to the left lower eyelid. The pain, she said, was temporarily relieved by "sticking a big needle in it through my nose." The mass produced no pain but caused partial nasal obstruction and partial obliteration of the nasofacial fold.

Examination revealed a mass about the size of a pea in the floor of the left nostril, anterior to the bony parts. It extended up under the anterior tip of the left inferior turbinate, pressing it upward and medialward. The mass was of rather firm consistency. On the left side of the left nostril a moderately firm, nontender mass was palpated. This appeared to extend to, and be continuous with, the mass in the nasal vestibule. Surgical removal was advised and the date set for March 1, 1948. However, a few days before the operation was to have been performed, the patient cancelled the engagement due to the fact that the mass had receded in size. She has been advised of its probable recurrence and again urged to undergo the procedure.

Diagnosis: Nasoalveolar cyst.

CONCLUSIONS

1. Nasoalveolar cysts constitute a condition about which rhinologists should be more cognizant. These cysts are considered rare but they are not as rare as they seem because the diagnosis is fre-

quently overlooked. Sooy may have misinterpreted Meyer when he quoted the latter as saying that one such cyst occurred in each 1000 persons. The type of cyst referred to by Meyer was of the median alveolar variety, which appears to fall into Thoma's classification as "nasopalatine cyst."

2. The diagnosis and treatment are relatively simple once the condition is recognized.

3. Nasoalveolar cysts are of fissural origin, being derived from the ectodermal rests.

4. The lining membrane is typically columnar, with or without cilia. However, there may be considerable variation owing to the possibility of infection and pressure over different areas of the cyst producing changes in the type of epithelial lining.

5. These cysts rest *on* bone and not in bone.

6. Whether they contain cholesterol is of little importance in differential diagnosis according to Laszlo, who quotes Darlington.¹⁵

7. These cysts occur almost exclusively in women, as shown by a comprehensive review of the literature and substantiated by our three cases.

CLEVELAND CLINIC.

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XVII

CYSTS OF THE NASAL VESTIBULE

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Although there is a fairly large world literature on cysts of the nasal vestibule, few reports have appeared in this country. No mention of the nasal vestibular cyst can be found in our textbooks on nose and throat diseases although they are mentioned in some detail in foreign texts and in oral surgery manuals. As this cyst will often present itself in the nose and the patient consult an otolaryngologist, this paper is intended primarily to bring this benign cyst to the attention of otolaryngologists, so that it may be readily recognized when seen.

Zuckerkindl,³⁰ in 1882, was the first to report a cyst of the nasal vestibule. In 1929, Arnoldi¹⁰ had collected some 72 cases in the world literature, and since, some 45 cases have been added. This report will add another three cases which were seen within a period of two months at the Presbyterian Hospital in New York City.

REPORT OF CASES

CASE 1.—Our first case was that of a 39-year-old negress admitted to the hospital on September 29, 1947, following a fall in which she sustained injury to the face. Examination at the time of admission revealed ecchymosis and slightly tender swelling of the left side of the face, a loss of the nasojugal fold on the left, and a large, depressible, non-tender mass occluding the left nasal airway. This mass was seen to lie immediately in front of the anterior end of the inferior turbinate. On questioning the patient further it was found that she had been aware of a small lump in her nose for a period of over 13 years, but as it had never caused her any trouble, she had not consulted a physician. On the day following admission the swelling was aspirated through the nose and 1.5 cc. of bloody

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fluid was obtained which failed to grow any organisms on culture. X-ray films of the sinuses and teeth were negative. A diagnosis of hemorrhage into a nasal vestibular cyst following trauma to the face was made. The cyst was removed under local anesthesia using a buccal approach and the diagnosis was confirmed microscopically.

CASE 2.—The second case was that of a 49-year-old negro who gave the history of having a "lump" on the side of his left nostril for a period of six months. This "lump" had once been irrigated with relief and on several occasions had spontaneously ruptured into the nasal cavity. Examination revealed facial asymmetry due to the absence of the nasojugal fold and a small, non-tender, slightly depressible, mobile mass bulging into the nose just behind the nasal vestibule. The mass was not related to the inferior turbinate nor did it appear to be connected to the underlying structures. The mass could also be seen as a fullness in the gingivolabial sulcus when the upper lip was reflected upward. X-ray examination of the sinuses and teeth showed them to be essentially normal. A diagnosis of nasal vestibular cyst was made and it was removed through a buccal incision. The clinical diagnosis was confirmed by histological examination.

CASE 3.—The third patient, a negress 41 years of age, had had a small swelling on the left side of her nose for four months. She gave the history of having had a similar swelling in that same area four years and again one year previously, but on both occasions the swelling had rapidly subsided by itself. This time, the swelling having shown no tendency toward regression, the patient began to worry. On examination the findings were essentially the same as those found in the preceding cases. The initial diagnosis of nasal vestibular cyst was confirmed by negative x-ray films of the sinuses and the teeth. The cyst was removed under local anesthesia using a buccal approach and the diagnosis confirmed by histological section.

These cysts of the nasal vestibule, or "kyste mucoid du seuil du plancher nasal",³⁴ "nasenvorhofszyste",¹⁷ considered very rare by Richier,²⁶ have been reported to occur as frequently as 1 in 1000 by some. Its occurrence would appear to be relatively rare as only three cases have been encountered in this clinic over a period of more than three years. The cyst is usually unilateral. Terracol³¹ and Kofler,¹⁷ both of whom reported cases with bilateral cysts, believe that these cysts are often bilateral, and in which case the patient presents

a typical Mongul appearance (Terracol). This bilaterality has not been borne out by a review of the literature. Numerous authors^{3, 14, 16, 25} have stated that the cyst occurred more frequently in females but this has not been substantiated by the literature, where the cases appear to be equally divided amongst male and female patients. Two of our cases were females, and one was a male. In all three of our cases the cyst was on the left side. Analysis of the available reported cases showed that the cyst occurred as frequently on the right side as on the left. All three of our cases were in negro patients, but it is impossible to draw any conclusions in regards to race. However, it may be said that atypical cysts as described by Bernfeld³ certainly appear to be more frequent in negroes.

The cyst may be accidental finding during a routine nose examination as in our first case. Usually, however, the patient will seek advice because of a small lump on the side of the nose or because of a unilateral nasal obstruction. Sometimes the patient may even feel the mass just behind the entrance of the nose. He may complain of a feeling of fullness of the upper lip. Rarely is there any pain although pain over the maxilla and even in the eye has been reported.^{13, 36} On examination there is a very definite asymmetry of the face due to the fullness of the upper lip and to the disappearance of the nasojugal sulcus on the effected side. On raising the tip of the nose a growth may be seen the size of a pea or even that of a small mandarin and cause a varying degree of obstruction. The mass lies on the floor of the nose behind the nasal vestibule and immediately in front of the anterior end of the inferior turbinate of which it is independent. The cyst may grow to such a size as to completely fill the nasal vestibule. On reflecting the upper lip upward, a fullness may be seen corresponding to the pyriform crest. The cyst is covered by a normal looking mucous membrane both in the nose and in the mouth. Palpation is better done bidigitally, one finger in the nose and the other in the mouth. The mass is found to be smooth, non-tender, somewhat depressible and mobile. It is, however, somewhat fixed to the mucous membrane in the nose and as will be seen later, the nasal mucous membrane is usually button-holed on removal of the cyst. This sense of mobility may at times be absent when the cyst lies in a small impression or mold in the bone.¹⁷ This, according to Uffenorde,³⁶ is a sign of pressure atrophy of the bony pyriform crest. There may be pain and tenderness when the cyst is infected. Examination of the surrounding structures is usually essentially negative. The teeth and sinuses are normal and

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x-ray examination confirms the absence of any relationship between the cyst and these structures. Aspiration of the cyst may be done, in which case every precaution of asepsis should be taken as the cyst can easily become infected. The aspirated fluid is straw-colored and of a mucoid character and it does not contain any cholesterol, which, to many authors, is an important diagnostic finding. This fluid is sterile unless the cyst has become infected secondarily. For more certain diagnosis the cyst may be injected with a radiopaque substance which will show the presence of a small cyst in the nasal vestibule, lying horse-back on the pyriform crest. The bone of the pyriform crest, the sinuses and the teeth are all normal and show no connection nor relation to the cyst.

The cyst is a relatively slow-growing one. The average time before the patient seeks advice is between six months and one year. The longest case reported was one by Kofler¹⁷ where the patient had had the cyst for a period of ten years. Our first case had noted the presence of a small lump 13 years ago, since which time it had remained about the same and had given the patient no trouble. Because of its vulnerable position, the nasal vestibular cyst is very prone to become infected, especially through trauma such as scratching of the nose. When infection sets in, a more or less severe reaction of the surrounding tissues may occur, and eventually the cyst will fistulize. Repeated episodes such as this are frequent and in this case the history of a pre-existing small lump is very important in making the differential diagnosis between the cyst and a furuncle of the nasal vestibule. Malignant degeneration of the cyst is very rare, only one case having been reported.⁴⁰

Bernfeld⁹ divides cysts of the nasal floor into typical and atypical cysts. According to this author, the classification is made on clinical and not on genetical signs. This atypical cyst is described as a small fold or cushion of mucous membrane frequently found on the floor of the nose just behind and lateral to the nasal entrance.

A differential diagnosis must be made with the following:

Furuncle of the nasal vestibule. An infected vestibular cyst is very likely to be mistaken for a furuncle if the history of a pre-existing lump in the nasal vestibule is missed.

Cysts of dental origin can be differentiated by careful examination and palpation, the presence of crepitation, of an infected tooth, bony erosion on x-ray examination, etc.

Gerber's pad will readily be diagnosed by x-ray examination of the incisor and canine teeth.

Other cysts of non-dental origin. According to Roper-Hall²⁷ there are two other types of cysts of non-dental origin which may be found in the premaxillary region: fissural or globulomaxillary cyst which occurs within the alveolus between the lateral incisor and its neighbour, and which is recognized by the fact that it lies in the alveolus and pushes the tooth to one side, and cyst of the incisive canal which lies in the midline and more often projects into the oral cavity than into the nose. When it does project into the nose it is seen to lie immediately next to the septum and not on the lateral portion of the floor of the nose.

Numerous histological sections have confirmed Brown-Kelley's first description of the nasal vestibular cyst in 1898.⁴² The cyst presents a fibrous capsule with loose connective tissue on its periphery. The epithelial lining is columnar or cuboidal and ciliated. The ciliated epithelium may at times be replaced by a stratified squamous cell type. Very often the epithelium may be cuboidal at one area and ciliated columnar at another. Various degrees of cellular infiltration, depending on secondary infection, may be found. Goblet cells are found throughout.

Numerous theories have been advanced to explain the pathogenesis of the nasal vestibular cyst, most of which have now been discarded. Evidence points to an embryological origin and Klestadt's explanation¹⁸ is the one most generally accepted today. Klestadt believes that the cyst arises from an inclusion of ectodermal tissue in the lateral nasal cleft occurring during the course of the embryological development of the face. Many do not accept this theory, in particular Brueggermann⁶, who, on the basis of studies on animals by Peter,²⁴ Tuffers⁴⁵ and Monesi²¹, believes that the cyst arises from an anteriorly misplaced lachrymal duct. It is interesting to note that Klestadt himself did not refute this theory but accepted it by stating that there were two types of nasal vestibular cysts: those cysts originating from the facial cleft and those originating from either the lachrymal duct or from the nasopalatine duct in the case of medial nasal cysts. Either one of these theories may be correct, and until further proof is given this question remains open for discussion.

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Various methods of treatment have been advocated. Aspiration of the cyst followed by injection of zinc chloride⁴¹, of lugol⁴⁴, destruction with cauter⁸, marsupialization³⁴, etc. Complete surgical removal is the only treatment that assures cure.

The cyst may be removed through the nose⁴³ but excision through an oral approach appears to us much more satisfactory. Under local infiltration, an incision similar but more medial to a Caldwell-Luc incision is made in the gingival mucosa. The soft tissues are elevated towards the pyriform crest until the mass is encountered. The mass is then dissected out, care being taken that it is not torn. It would appear that the cyst is always very adherent to the mucous membrane of the floor of the nose and it is not unusual that this mucous membrane be buttonholed, an accident which has little or no importance. The incision is then closed without drain and healing is complete within five to six days.

SUMMARY.

1. Three cases of nasal vestibular cysts are reported.
2. Evidence points to embryological origin of these cysts, either inclusion in the lateral facial cleft or prolongation of the lachrymal duct.
3. These cysts may easily be removed through a buccal approach.

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Clinical Notes

XVIII

NEURINOMA OF THE FACIAL NERVE IN THE PAROTID GLAND

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Reports of the occurrence of neurinoma of the facial nerve are rare. This is attested by the fact that the entire literature records but fifteen cases. All fifteen have had origin in the nerve sheath within the fallopian canal: five from the horizontal, and ten from the descending portion. The case reported here has the singular merit of having origin in the facial, or extracranial, distribution of the seventh nerve.

In 1935, Altmann¹ published a comprehensive analysis of these tumors, using as material three cases of his own and three reported by other writers. In so doing, he established the facts that neurinoma of the facial nerve is a definite clinical entity, and characteristically produces the progression of symptoms of facial paralysis, loss of hearing, chronic infection of the middle ear and/or mastoid process, and intracranial extensions. Roberts' article,² published in 1943, cites his case, the thirteenth, and recounts a detailed résumé of all the previously reported cases. The résumé precludes repetition, but in essence it makes obvious the remarkable similarity in symptomatology and pathology of this tumor. Included in this résumé is the case reported by Williams and Pastore published in 1939, the first contribution to the American literature.

Bogdasarian's presentation,³ published in October, 1944, is noteworthy in two particulars: for its recording of a diagnosis made preoperatively, and for the correlation of the clinicopathologic findings of such tumors having origin in the several parts of the fallopian canal. He comments:

"This type of tumor arises from the nerve sheath and is expansive in its growth, following the line of least resistance. In the first and third portions of

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the fallopian canal the bony walls are more resistant to expansion than in the second portion: hence, the onset of paralysis may be earlier with the tumor in either of the former locations than with one in the latter location. If the tumor should arise in the internal auditory meatus, facial paralysis would occur first, followed by a nerve type deafness if the auditory nerve should become involved. (This has not been seen clinically.) If the tumor occurs in the third portion of the facial nerve, paralysis occurs together with the appearance of a polyp in the innermost portion of the posterior-inferior wall of the external canal, with intact drum membrane and middle ear (Schmidt, cited by Altmann.) This may or may not be followed by the conductive type of deafness, depending on the extent of growth and the invasion of the middle ear. However, if the tumor arises in the second portion of the facial nerve, where resistance is minimal owing to the space of the middle ear cavity, deafness of varying degrees and types occurs as the first presenting symptom, depending on whether the disturbance affects the movements of the ossicles or leads to fixation of the footplate of the stapes or to occlusion of the round window . . .

"Labyrinthine disturbances may occur in cases in which the tumor has progressed further, and with secondary infection the same complications may arise as are seen in disease of the middle ear."

Histologically, neurinomas are classified as benign tumors. They grow slowly, are well encapsulated, and show little tendency towards metaplasia. They may, however, by means of mechanical and physical expansion and growth, erode, invade, and destroy adjacent structures. Degenerative changes, due to inadequate vascularity, may occur, leading to scattered areas of necrosis and false cyst formation. They are differentiated from neurofibromata in that the microscopy of neurofibromata shows these tumors to arise from the connective tissue of the nerve, while the neurinomas are products of the proliferation of Schwann cells or analogous elements. Hence, neurofibromata are essentially simple fibromas with nerves running through and around them, while neurinomas are true tumors of nerve fibres.

According to Ehrlich and Martin:⁴

"It has been customary to divide the histologic picture of this nerve sheath tumor into the type A and type B tissues of Antoni. This classification is so specific and descriptive as to warrant its continued use.

"Type A tissue is characterized by a reticulum of fine, long fibres which pass between the cells. The cells and their nuclei are elongated and cytoplasmic processes stream out to form a network. The intracellular fibres are in parallel arrangement, while the elongated cell nuclei are lined up at the opposite end of the fibres. This produces a palisading pattern, which is so characteristic of schwannoma. The cells and fibres also form whorls.

"Areas of fibrosis and necrosis are invariably encountered in this portion of the tumor. Hemorrhage, too, is a common occurrence, as well as thromboses within the thick walled blood vessels. This necrotizing process produces areas in which fibres have disappeared and only cells remain, or areas in which the reticulum is devoid of cells.

"In the type B tissue, there is no orderly arrangement of cells and fibres, and therefore no palisading of nuclei is seen. This phase is characterized by an accumulation of intracellular fluid and the appearance varies from one of edema which dissects the tissue apart, to microscopic degeneration."

REPORT OF A CASE

On July 8, 1947, M. G., a 57-year-old white male was transferred from the Norristown State Hospital for the Insane to the Philadelphia General Hospital, because of the presence of a rather large mass on the left side of his face, of two years' duration.

The patient's mental state rendered him an unreliable informant and hence the following history is that which accompanied the patient on transfer.

The onset of this swelling was first noticed by the patient approximately two years ago. Its growth was slow, and very gradually it attained the size of a lemon. It was free of pain and tenderness and did not interfere with either mastication or swallowing. During the month of January, 1947, there was first observed mild paresis of the left side of the face. In the ensuing six months this paresis increased in intensity and distribution until it involved all branches of the facial nerve except the cervical.

The family history was irrelevant and the personal history significant in only one respect: the patient stated that about five years ago he was struck on the left side of his jaw.

Physical examination showed a well nourished adult white male, who appeared neither acutely nor chronically ill. Since the examination in general revealed nothing pertinent to the chief complaint, only the findings of the examination of the head and neck will be recorded. The patient wore glasses; the pupils were round and equal, and reacted to light and accommodation; no ocular palsies were noted. The nose was clean and free of purulent discharge and obstructive phenomena. The mouth was edentulous; the tongue protruded in the midline and showed no evidence of fibrillation. The pharyngeal reflexes were intact; there was no evidence of infection nor tumor formation in the oropharynx. The larynx was normal in appearance and motility. Both ear drums were slightly thickened and retracted. On the left side of the patient's face, anterior to and above the angle of the jaw, and overlying the body of the parotid gland, there was a large smooth mass about the size of a lemon. The mass was only moderately firm to the touch, was fixed to the under-

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Fig. 1.—Photomicrograph illustrating the essential histologic structure of neurinoma : the well defined capsule, the whorls of spindular elements with elongated nuclei arranged in a palisading pattern, and the early formation of small cystic spaces. (x 100).

lying structures but was not adherent to the skin. It was not tender to palpation. There were no palpable cervical lymph nodes. There was an incomplete paralysis of all the branches of the facial nerve on the left side.

On July 9, 1947, aspiration biopsy was performed. The material was reported as insufficient to afford a histologic diagnosis. The clinical impression at this time was adenoma of the parotid gland, probably undergoing malignant change. It appeared to be operable, and on July 14, 1947, using intratracheal ether anesthesia, resection was attempted.

Exposure of the tumor mass was easily and adequately effected until the dissection reached its base. Here it was seen that the mass was attached to the substance of the parotid gland by means of multiple, broad finger-like projections. Dissection of these was a very trying and, ultimately, impossible task. Interpreting the presence of the facial paralysis and the diffuse attachment of the tumor

to the gland substance as indicative of malignancy, the operator then decided to sacrifice the facial nerve and to totally resect the parotid gland. This was done. The wound was then closed without drainage and the postoperative course was uneventful.

The report of the pathologist was as follows: "Specimen consists of two masses of tissue apparently joined by a piece of fascia. One mass is 4 cm. x 4 cm. x 1.5 cm. and is dark purple in color. The other, 4 cm. x 3 cm. x 2 cm., is pale tan, and on section is somewhat translucent and smooth.

"Microscopic examination of the larger mass described above reveals what appears to be essentially normal parotid gland. The other smaller mass consists of whorls of spindle elements with elongated nuclei of various sizes showing no mitotic activity.

"Pathologic Diagnosis: Schwannoma."

COMMENT

Although Altmann, in 1935, was able to identify such facial nerve tumors as specific entities, he did so with very scant material. His observations, however, were so astute that subsequent reports have only substantiated his conclusions. The addition to the literature of a clinicopathological analysis by Bogdasarian in 1943 further establishes a true anatomical differentiation for these tumors occurring in the various parts of the fallopian canal, and at the same time furnishes a rationale for a preoperative diagnosis.

This report, citing the occurrence of a neurinoma of the facial nerve in the area of the parotid gland emphasizes a statement by Ehrlich and Martin that such tumors may occur anywhere in the course of a peripheral nerve. As such, they must be included in the differential diagnosis of parotid gland neoplasms.

Essentially benign, they present all the characteristics of a benign tumor except that they produce facial nerve paresis early. The development of such a paresis in association with a painless, smooth, slow-growing tumor mass anywhere in the distribution of the facial nerve should be sufficient evidence to cause the examiner to include this type of tumor as a diagnostic possibility. Ultimate diagnosis necessarily is dependent upon the histologic study of tissue secured by biopsy.

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SUMMARY

Neurinoma of the facial nerve has been established as a specific entity. The symptomatology of these tumors occurring in any part of the fallopian canal is sufficiently constant to warrant a preoperative diagnosis.

That such tumors may involve the facial nerve outside the fallopian canal is here illustrated. Being without precedent, it is difficult to establish a specific sequence of developmental signs. As is common to all benign tumors, it is smooth, well encapsulated, painless and grows slowly: the additional development of early facial paresis should suggest the existence of such a possibility in the differential diagnosis.

255 SOUTH 17TH ST.

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XIX

CONGENITAL POSTERIOR CHOANAL OCCLUSION

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The condition in which there is a complete separation of the nasal fossae from the nasopharynx by either an osseous or a membranous partition is a grave occurrence in the newborn. The rhinologist owes it to the obstetrician, the pediatrician, and the general practitioner to emphasize its gravity properly, and to recognize it as a possible cause of the symptoms in cases of immediate difficulty in nursing or breathing. He should indicate its role in cases of so-called asphyxia neonatorum, of "blue baby", and in some cases mistakenly diagnosed as arrested respiration.

This anomaly was first noted in autopsy material by Otto¹¹ in 1814 but the first clinical case was not described until 1853, when Emmert⁷ published his report. Wilkerson and Cayce,¹⁵ in their recent survey of the literature, found a total of only 269 cases reported in the past 95 years. Reports from the literature tend to show that the condition is meeting with more general recognition, and that in the near future the incidence will probably be much higher.

Schaeffer¹⁴ and Brownell¹³ point out that in the embryological development of the nose there is a stage in which the nasal chambers, as they grow dorsal-ward, are separated from the cranial aspect of the pharynx by the bucconasal membrane. This structure varies in thickness, and is composed of a layer of mesenchyme separated by epithelium on its nasal and pharyngeal surfaces. Ordinarily, between the thirty-fifth and the thirty-eighth day of fetal life, this membrane becomes so attenuated that rupture soon occurs, thus establishing the normal continuity between the nasal and nasopharyngeal cavity. The persistence of this structure results in occlusion of

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the posterior choanae. The extent of the resorption of the mesenchyme between the nasal and the pharyngeal epithelium determines whether the atresia is to be membranous or osseous, or both.

Anderson¹ and Boyd² have stated two other possibilities as to the etiology of this condition: 1) the persistence of the buccopharyngeal membrane, and 2) overgrowth of the vertical and horizontal processes of the maxilla. When the atresia is membranous it is probably caused by the persistence of the nasobuccal membrane, but when the occlusion is bony there seems to be some uncertainty as to its origin. The bone forming the obstruction has been shown to be formed from cartilage, indicating that it probably was formed from persistence of the buccopharyngeal membrane.

The symptoms and problems of diagnosis of choanal occlusion vary with the type of occlusion and the age of the patient. In the newborn, the difficulty in breathing becomes alarming if the obstruction is bilateral, but the symptoms of severe dyspnea and cyanosis disappear when the infant begins to cry. With the mouth open oxygenation is re-established, but the impelling instinct of nasal breathing soon asserts itself, and when the mouth closes there is a repetition of the dyspnea and cyanosis.

Donnelly⁵ indicates that the "cyclic" character of this type of dyspnea should be recognized by all obstetricians. When choanal obstruction is present on only one side, respiratory embarrassment is not conspicuous but may manifest itself at nursing time, and is frequently attributed to an enlarged thymus. After the nursing period, the impairment in breathing is no longer noted and the problem seems solved. Only in childhood or in later years is advice usually sought.

The physical findings commonly seen in this condition are widening of the nasal chambers due to faulty growth or to atrophy of the turbinates, glairy mucus on the floor of the nose, anosmia, and a high arched palate. More definitely, there is inability to pass a probe from the nose into the nasopharynx, and on posterior rhinoscopy the typical posture of occlusion of the nasopharynx is seen. An absolute diagnosis of this condition may be made by instilling iodized oil into the nose and demonstrating by x-ray films its failure to pass into the nasopharynx.

Simple removal of the occluding bone and its covering membrane is usually not entirely satisfactory because of the fact that

postoperative cicatricial stenosis of the choana may result. The accepted procedure at the present time, according to Brownell,³ consists of removal of the occluding bone or membrane and the postero-inferior portion of the nasal septum, as a result of which the two choanae are joined and the communication between the nasal chambers and the nasopharynx is enlarged. Thus some degree of cicatricial stenosis does not result in occlusion of the communication between the nose and the nasopharynx. Childrey⁴ also emphasizes the importance of resecting the posterior portion of the nasal septum as well as the occluding membrane.

An important point noted by Kelly⁵ is that sufficient emphasis is never put upon the great thickness of bone with which the surgeon may have to contend. Although the center of the obstruction is often quite thin, the lateral aspect may be very thick and very hard, and to eradicate it a chisel or an electrically driven bur may be required.

Kazanjian⁸ reported three cases of children over nine years of age in which he elevated the columella, displaced the cartilaginous septum to one side, and then removed the posterior vomer and the perpendicular plate of the ethmoid; thus he converted the posterior part of the nose into a single wide chamber communicating with the nasopharynx. He pointed out that most operators agree that the best surgical approach for relief of the obstruction is the intranasal route beginning with resection of the septum and continuing further until the obstruction is reached.

Wilkerson¹⁵ also recommends attacking the obstruction by the intranasal route. He, however, advocates the use of a long-shanked, electrically driven bur with a flat smooth tip, using low or moderate speed.

Durwood, Lord, and Polson⁶ confine themselves to no particular method of attacking this problem, but believe that the choice, whether it be the bur, mallet and gouge, or curet is entirely up to the individual. To prevent reclosure by granulation tissue and cicatrization, they use the following methods: A tube or sound may be inserted into the newly made opening, the raw edges of the wound may be covered with a mucosal flap from the partition, or a portion of the nasal septum and the vomer may be removed.

Ruddy¹³ discusses the direct approach through the nares, the intranasal approach following a submucous resection in which the posterior portion of the vomer is removed, and the transpalatine approach, and cites his experience with this latter approach in one

anesthesia was complete. Postoperative care was confined mainly to keeping the tracheotomy cannulae patent with suction, and changing the tubes every other day. Figure 2 shows the cannulae in place.

Three weeks after admission the child had gained 740 gm. in weight. Figure 1*b* shows a postoperative lipiodal instillation, with the contrast material passing from the nose into the pharynx.

The obturators were removed from the nasal cavities on the seventeenth postoperative day, and the child was discharged from the hospital seven days later. Two months later the preoperative weight had been doubled and normal nasal respiration was present. At the ninth postoperative month the child had continued to gain weight in a normal fashion and both posterior choanal openings were patent.

CONCLUSIONS

1. Congenital posterior occlusion can be a serious condition in the newborn.
2. The condition is amenable to surgical procedures.
3. It should be considered in the etiology of all cases of respiratory difficulty in the newborn.

1020 HURON ROAD.

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Fig. 2.—Roentgenogram showing cannulae in place.

A Breck feeder was used to improve the patient's nutritional status. After seven days of this type of feeding, supplemented by adequate vitamin and iron intake, operation was performed under ether anesthesia. The inferior turbinates were outfractured, and under direct vision a small gouge was used to break through the bony partition between the nose and the nasopharynx on the right side, a Frazier brain retractor first having been placed in the nasopharynx to protect the posterior pharyngeal wall from trauma. The opening was enlarged with a sphenoid punch until the inner cannula of a No. 2 tracheotomy tube was admitted freely. This No. 2 tracheotomy inner cannula allowed free passage of the air between the nose and the nasopharynx. The same procedure was then performed on the left nasal cavity where a similar bony partition separated the nose from the nasopharynx. The inner cannulae were taped in place in both nares as obturators, and the patient was seen to have free nasal breathing.

The postoperative course was essentially uncomplicated. The infant was able to feed in a normal fashion as soon as recovery from



Fig. 1a.—Preoperative intranasal lipiodol instillation.



Fig. 1b.—Postoperative lipiodol instillation.

since birth and weight gain had been poor because of difficulty in feeding.

Physical examination revealed a well developed, poorly nourished white male infant breathing entirely through the mouth with a moderate amount of mucopurulent discharge from both nares. The skin was loose and wrinkled, and turgor was poor. A probe passed into both nostrils could not reach the nasopharynx because of a bony obstruction. Direct examination of the nose demonstrated the complete obstruction in the posterior part of both nasal fossae. There was slight injection of the nasopharynx and the pharynx. The remainder of the physical examination was essentially negative.

The white blood count was 9,000; the hemoglobin was 14.1 gm. Bleeding and clotting time and prothrombin were normal. X-ray films of the nasal cavity were taken after iodized oil had been injected into both nasal cavities. The film (Fig. 1a) showed no contrast material entering the nasopharynx which was positive evidence of the bilateral choanal obstruction.

case. A curved incision was made through the mucosa of the hard palate just anterior to the posterior border of the hard palate, taking care to avoid the vessels and nerves of the greater palatine foramen. The bone of the hard palate was removed posteriorly in addition to the vomer bone of the septum, and then the choanal obstruction was removed under direct vision. A rubber catheter held in place by an inflated balloon was used to prevent postoperative contraction. Donnelly's⁸ method is to remove the bony obstruction, and to insert into the opening a French woven catheter around which has been fitted a full thickness skin graft so that the raw surface of the graft is in contact with the freshly denuded area of the choanae. This is anchored in place and allowed to remain for ten days after operation.

Klaff¹⁰ reported a case of a 26-year-old white male with bilateral congenital atresia of the posterior choana. His method of treatment was to split the soft palate and, with a finger in the nasopharynx, to break down the obstruction with a rasp.

Pastore and Williams¹² report a case of a newborn child who was operated on at the age of nine days. The choanal occlusion was due to dense, thick bone. Rubber catheters were inserted to preserve the patency of the artificial choanae.

Wright, Shambaugh, and Green¹⁶ present a case of unilateral posterior choanal occlusion and describe their method of attacking the obstruction through the transantral approach. Using local anesthesia and blocking the second division of the fifth cranial nerve in the posterior palatine canal, the authors used the usual Caldwell-Luc exposure of the antrum and made a second opening in the antrum posteriorly on its medial wall, thus gaining entrance into the nasal cavity far posteriorly. The posterior tip of the inferior turbinate was removed and the obstruction exposed. In this case the authors found the obstruction so hard and thick that the bone was left in situ, and the perforation was made in the nasal septum to communicate with the opposite side of the nasal cavity. The authors claim that the advantage of this method is the ready accessibility to the sphenopalatine artery in case of severe bleeding.

REPORT OF A CASE

G. B., an eight-weeks-old white male, was brought into the hospital by the mother who said the child had been unable to breathe through its nose since birth. The child had done only fairly well

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XX

ONCOCYTIC CYSTADENOMA OF THE LARYNX

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"Oncocyte" is a descriptive term applied to a particular type of cell found in various organs. This appellation was popularized by the writings of Hamperl¹ in the 1930's. However, these cells were first noted by Schaffer² in 1897 and called "granular swollen cells." Later researchers termed these same cells "pyknocytes" because of their pyknotic nuclei.

Oncocytes are a peculiar type of epithelial cell which resemble the cells of the organ in which they are found. They are large cells or, at least, larger than their neighbors, and have nuclei which either resemble those of the parent organ or are somewhat pyknotic. Their outstanding characteristic is a finely granular, acidophilic cytoplasm which renders them easily identifiable within the tissues. These oncocytes have been found in the tongue, pharynx, uvula, esophagus, salivary glands, all parts of the pituitary gland, liver, pancreas, testes, uterine tubes, nasal mucosa, trachea, bronchi and larynx. It is of further interest that the shape of oncocytes varies according to the epithelium from which they arose. They may occur only in adults, rarely before the age of 50, and quite regularly at the age of 70 and above. Hamperl and others have noted that transitional forms were to be found between the oncocyte and the normal functioning cells of mucous or serous glands. Amitosis has been noted by various observers.

Our knowledge of the origin and function of oncocytes is incomplete, according to writers on the subject. Their origin has been variously regarded as: 1) a regenerative process; 2) a degenerative

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process; 3) a secondary senile change in the vascular system; 4) an independent phenomenon of senility which is characteristic of glandular tissue; 5) unknown. The weight of opinion is in favor of the two last.

Occasionally, oncocytes may give rise to a nodular hyperplasia or they may even be the origin of a rare neoplasm known as an oncocytoma. Cystadenoma papillare and adenolymphoma of the parotid are considered by many workers as examples of these tumors. The most recent reports have been those of Ackerman³ who found the tumors in the parotid, and Palmer⁴ who found them in the trachea. They are universally considered as benign lesions although oncocytes have occasionally been noted in malignant growths. Stout⁵ considers it possible that they may be the stem cells of bronchial adenoma. Cyndroma, especially of the bronchus, has been considered by some authors as having a relationship to oncocytoma.

Cysts of the larynx are classified by Lederer⁶ as: 1) congenital or embryonal, 2) due to retention, 3) distention of lymphatic or blood channels, and 4) traumatic. The present case does not apparently fall into the classification, but is related rather to the cystomata or cystadenomata. Figi, Rowland and New⁷ reported four cases of cystadenoma of the larynx which they added to less than 20 cases previously accumulated in the literature. In none of the cases reported or reviewed were oncocytes mentioned. They noted that the incidence was most often in males and almost always in adults. The most usual location was in the ventricle or the ventricular bands, although they seemed to occur anywhere in the larynx, with the exception of the true vocal cords. Etiologic factors are said to be retention of secretion with consequent overgrowth of glandular or connective tissue. Blockage or absence of ducts with continued secretion may also produce cystic dilatation.

Nohter⁸ reported the presence of oncocytes in 8 of 37 larynges examined routinely at postmortem; all cases presenting oncocytes were 52 years of age or more. Oncocytes were found in 20 of 41 autopsy specimens of nasal mucosa within the same age group.

Nohter, in the same report, presented a case of a tumor of the right aryepiglottic fold which proved to be a single cyst. The lining consisted of ciliated epithelium whose epithelial cells had mostly been replaced by oncocytes. This is the first case of a laryngeal cyst containing oncocytes reported in the literature.



Fig. 1.—Gross specimen after removal of laryngeal fissure. Remnants of true cord can be seen at lower border.



Fig. 2.—Series of long sections of gross specimen. The laryngeal ventricle is distended by cystic tumor.

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Recently, we observed an instance of multiple cysts of the larynx with oncocytes. These cysts, originating in the ventricle, recurred after removal and showed a tumorous tendency to infiltrate the soft structures of the larynx. The surgical specimen obtained by laryngofissure proved to be an oncocytic cystadenoma. A perusal of the available literature failed to reveal any similar case.

REPORT OF A CASE

A 50-year-old white female complained of increasing hoarseness of almost one year's duration. There was no evidence of dyspnea or ill health. The rest of the history was irrelevant except for a questionable attack of rheumatic fever in childhood.

Laryngeal examination revealed four cystic polypi protruding from the left ventricle and projecting medially over the true cord. Another small polypoid mass was noted in the right ventricle, anteriorly. The vocal cords were fully mobile and no other lesions were noted. The rest of the physical examination revealed only a mitral stenosis and insufficiency, apparently well compensated.

The cystic polypi were removed by indirect laryngoscopy and sent to the laboratory for examination.

Macroscopically, the polypi presented a whitish grey, globular appearance, the largest being about 1cm. in length. Histologically, the specimen consisted mainly of laryngeal glands, many of which were distended and cystic. In many of these cystic structures the epithelium had the character of oncocytes. Occasionally, the oncocytes lining the cavity appeared flattened. In a cross section of a duct near the surface, oncocytes, ordinary mucinous cells and stratified epithelium were found together.

Azocarmine stained some of the oncocytes bright orange and brought out their granular character well. Most of the oncocytes did not take the mucicarmine stain but some exhibited masses of typical red-staining mucus. There were no oncocytic goblet cells. The color of mucus in the oncocytes was identical with that of mucus in the ordinary laryngeal cells. The laryngeal stroma in places was edematous and contained some lymphocytes and plasma cells. The microscopic diagnosis of a partially oncocytic benign laryngeal cyst was made.



Fig. 3.—Photomicrograph showing tumorous character of lesion manifested by infiltration of growth into muscle (low magnification).

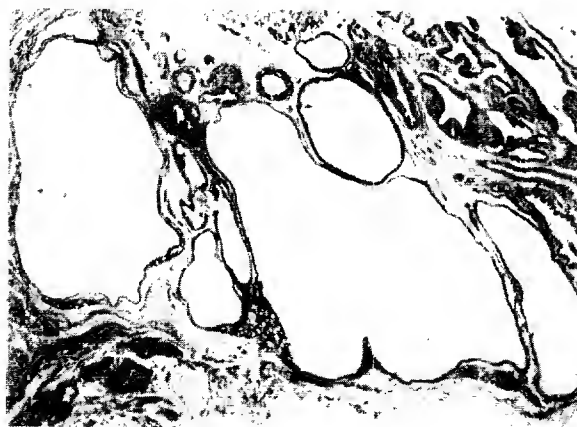


Fig. 4.—Photomicrograph showing multiple cysts with thin lining membrane which comprise most of the tumor mass.

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The patient returned some six weeks later complaining of slight air hunger on mild exertion and progressive hoarseness to the point of aphonia. There had been no amelioration of symptoms following the removal of the ventricular cysts.

The patient appeared aphonic, but not in distress. A laryngeal examination revealed that the left false cord and ventricle had become markedly thickened and presented a smooth bulge which obscured the left vocal cord. The induration extended as high as the base of the epiglottis and involved the left aryepiglottic fold. The ventricular mass encroached considerably on the lumen of the larynx. In addition, a smooth polypoid swelling could be seen in the anterior portion of the right laryngeal ventricle. The right cord was uninvolved and freely mobile. The left laryngeal wall was covered by an intact mucosa which presented several circular smooth prominences on its upper surface.

In view of the rapid increase in the size of the lesion in so short an interval, it was decided to extirpate it by laryngofissure. The tumor mass, although benign, now involved the anterior portion of the opposite ventricle and any surgical procedure short of complete eradication seemed contraindicated.

Operation: Under local anesthesia, the thyroid cartilage was split and the interior of the larynx was seen. A large greyish mass, originating in the left ventricle and involving the left false cord, was encountered. The true cord was displaced inferiorly. The mass extended into the left aryepiglottic fold toward the base of the epiglottis. At the level of the anterior commissure, there was a smaller cystic swelling extending below the glottis. An isolated cyst could be seen in the right ventricle anteriorly. The tumor was dissected subperichondrially across the anterior commissure so as to include the anterior third of the right vocal cord. It was then removed in toto from in front of the left vocal process to the area immediately behind the small cyst in the right ventricle. The bed of the tumor was coagulated with diathermy to arrest bleeding. Closure was performed in a routine fashion without resorting to tracheotomy.

The patient had an uncomplicated postoperative course and was discharged from the hospital within a week. The interior of the larynx was healed in almost a month and her voice is fair and easily understandable. The laryngeal airway is ample and there is no evidence of a recurrence to date, 18 months after the operation.

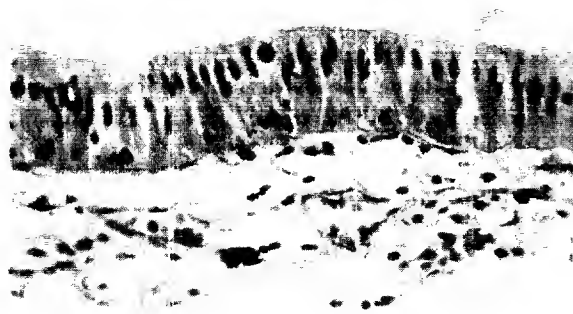


Fig. 5.—Photomicrograph showing oncocytes (high magnification). The large size of the individual cells, the pyknotic nuclei and the granular cytoplasm is characteristic.

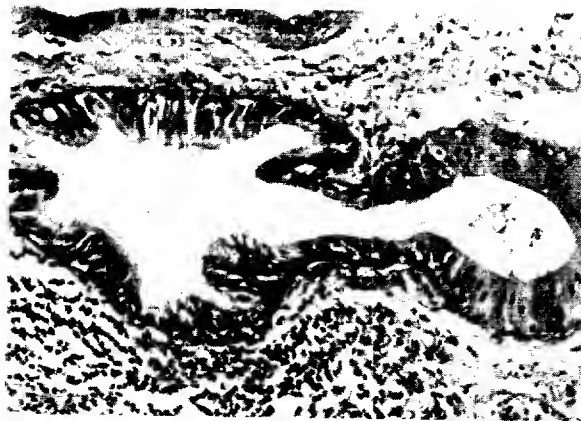


Fig. 6.—Photomicrograph of cyst wall (high magnification). The glandular structure and normal ciliated epithelium can be seen at the left. The intermediate flattened transitional cells are in the center and the mature oncocyte can be identified at the right.

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Pathological Report: Grossly, the resected piece of larynx (Fig. 1) measures 3 cm. in vertical direction, 2 cm. across, and its thickest portion is at the level of the false cord. Destroying the anterior portions of the true cord, a polypoid mass about 8 mm. in diameter encroaches upon the ventricle. Submucosally, beneath the epithelium of the false cord, a dull grey, moderately firm mass of indefinite outline, approximately 8 mm. in diameter, is found. The muscle which forms the upper half of the specimen appears thick, edematous and has numerous small glistening areas.

After fixation, a long section reveals that the thickened upper portion is converted into a honeycomb of small cysts (Fig. 2), some containing clear, others inspissated, material. The grey, firm, submucosal mass described above appears at some levels, continuous with the cystic structures.

Microscopic Report: The picture is essentially the same as described in the biopsy. The tumorous character, however, is marked, especially considering the deep penetration of muscle tissue by ordinary laryngeal glands and the oncocytic glands (Fig. 3). As previously mentioned, oncocytes and ordinary glandular epithelium are found side by side. In the distended glands and cysts, many oncocytes are flattened (Fig. 4). Intermediate stages are easily found; next to a typical normal epithelial cell one with slight eosinophilia is located, while the next cell is more eosinophilic and shows traces of granulation (Fig. 6). Some oncocytes, while being eosinophilic and granular, have the shape and size of normal epithelial cells, while others exhibit the characteristic high cylindrical shape with a varying position of the nucleus (Fig. 5). Oblique sections through narrow glands with thick oncocytic epithelium simulate semisolid oncocytic areas. Only very occasional papillae are found. Spur-like remnants of cyst walls, which have become atrophic under the pressure of the secreted material, in places simulate papillae.

There are some small lymphoid masses under the oncocytic epithelium. Occasionally they contain scattered, otherwise normal, laryngeal glands. Similar laryngeal glands show atrophy and fibrosis; some are situated in fat tissue. No oncocytes are found in the surface epithelium, but the glandular ducts near the surface contain oncocytes in varying numbers within their stratified epithelium. There obviously is overgrowth of ordinary laryngeal glands, in places with distension by mucus.

This singular case of oncocytic cystadenoma cannot be classified with the previously reported benign laryngeal cysts. Although the

histological picture is definitely benign, the penetration of muscle and fat tissue is most unusual. Such evidence of local invasion is quite different from the ordinary involvement of adjacent laryngeal structures by pressure from an expanding laryngeal cyst. The neoplastic character of the growth is also manifested by the rapid spread of the tumor grossly in so short an interval. The presence of numerous cystic tumors in the larynx is rather unique, solitary cysts being the general rule.

An additional striking feature of this case is the multicentric origin of the cysts involving both ventricles simultaneously. The predominance of oncocytes in the lining membrane of these cysts is certainly bizarre. The exact role these peculiar cells play in the pathogenesis of the tumor is nebulous. The transformation of a normal mucous cell to a mature oncocyte can be observed in many sections.

BETH ISRAEL HOSPITAL.

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XXI

FACTORS CAUSING DELAY IN THE DIAGNOSIS OF
LYMPHOBLASTOMA

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While it is well to seek a common denominator for all tissue variations, the presence of multiple disease entities, concurrently and successively, is not unusual and must be kept in mind. An example of such multiple pathology presented itself in a case in which lymphoblastoma of the left tonsil followed gynecological disease necessitating surgery.

REPORT OF A CASE

S. R., aged 54, weight 180 lbs., presented herself to one of us (H. A. S.) on November 19, 1946, with vague pains in the lower abdomen, especially in the right lower quadrant, for the past two years, aggravated by exertion, and a protrusion from the vagina which she first noticed following the birth of her last child 18 years before. The patient would push the protruding mass back into the vagina and obtain temporary relief. She also had stress incontinence, and vaginal discharge had been present for the past two years.

The past medical and surgical history was negative. Her menarche began at the age of sixteen, but her periods were never regular, with episodes of amenorrhea lasting as long as seven months on occasion. She would have menorrhagia with the first period following amenorrhea. There was no metrorrhagia. She was a Gravida III, Para III, and had no miscarriages. Her last pregnancy terminated in a full term normal spontaneous delivery in July, 1929. Her menses ceased in 1943. There was no bleeding after that time.

From the Departments of Otolaryngology and of Obstetrics and Gynecology of the University of Illinois and the Mt. Sinai Hospital.

The physical examination revealed the head and neck to be negative. The heart was found to be slightly enlarged to the left, with an accentuated second pulmonic sound. The lungs were clear, and the abdomen revealed no masses nor tenderness, and only a slight diastasis. Her blood pressure was 180/90.

The pelvic examination revealed a multiparous, relaxed introitus, a two plus cystocele and a one plus rectocele. The Bartholin and Skene's glands and the urethra were negative. The cervix appeared small, atrophic, and three degrees retroverted. There was slight prolapse on straining, and the uterus could be brought to and beyond the introitus with minimal tenaculum tension. The adnexae were negative. Speculum examination revealed a minimal erosion of the cervix with an erosion type of Schiller stain. There was no evidence of leukoplakia or other precancerous lesion. Clinical diagnosis was therefore second degree prolapse, cystocele, third degree retroversion, chronic cervicitis, and stress incontinence.

On December 3, 1946, a vaginal hysterectomy and an anterior colporrhaphy were performed under gas-oxygen anesthesia. The uterus was found to be quite small and atrophic; and the cervix, elongated and hypertrophic.

Pathologic Examination—Gross: The specimen consists of an uterus, including the cervix, which together measure 4 cm. by 2.5 cm. by 9 cm. The external os is multiparous and the mucosa is injected and granular. The cervix is slightly elongated. The myometrium measures 15 mm. and contains two firm, well encapsulated nodes measuring 10 mm. by 7.5 mm. in diameter. The endometrium measures less than 1 mm. It is slightly injected and smooth.

Microscopic: Sections of the uterus reveal an atrophy of the myometrium and endometrium. Sections of the cervix reveal a slightly chronic endocervicitis with an erosion.

The patient was discharged from the hospital on December 14, 1946, the eleventh postoperative day, in good condition with no complaints.

On January 7, 1947, a postoperative check-up revealed the vaginal vault to be well suspended. The abdominal vaginal examination was negative. There were no pelvic masses nor tenderness, and there was no evidence of stress incontinence. However, at this visit.

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approximately one month postoperatively, she complained more or less casually of a pain in the right groin. She had also noted in the past few days the appearance of a swelling in the left side of her neck. Examination disclosed the mass in the neck to be enlarged cervical nodes. The swelling in the groin was attributed to a mild inguinal hernia as no definite nodes or masses were palpable, but the possibility of a generalized lymphadenopathy was considered.

It was thought advisable to refer her for a medical check-up, hematological survey, and possible biopsy to determine the pathology and etiology of these nodes. She had no symptoms nor findings referable to the nose or throat at this time.

A blood count on January 12, 1947, revealed the following: erythrocytes, 4,300,000; hemoglobin, 96%; color index, 1; leucocytes, 5,200. The differential count revealed neutrophils, 62%; lymphocytes, 32%; eosinophils, 1%; and monocytes, 5%.

There was very little change in the blood picture at this time as compared with the normal findings obtained in the hospital preoperatively.

On January 31, 1947, the patient was referred to the Research and Educational Hospital for further examination because the nodes of the neck were rapidly increasing in size, and she had developed dysphagia and other pressure symptoms. She was examined in the Admitting Clinic of that hospital on February 3, 1947, and referred to the Medical Department with a diagnosis of enlarged cervical lymph nodes of undetermined etiology.

Laboratory Findings: The urine was yellow in color, the reaction acid and the specific gravity 1.015. It contained a few epithelial and pus cells, but no albumin nor glucose. The Kahn test was negative. The blood count showed erythrocytes, 4,300,000; hemoglobin, 85%; and leucocytes, 5,000. The differential count revealed neutrophils, 72%; lymphocytes, 17%; eosinophils, 9%; basophils, 1%; and monocytes, 1%.

On February 7, 1947, the patient was referred to the Tumor Clinic with the conclusion that lymphadenopathy with negative blood findings were suggestive of lymphoblastoma. One of the posterior lymph nodes was excised for microscopic study. The pathologic findings were:

Gross Examination: A rounded encapsulated mass is received which grossly resembles a lymph node. It measures 1.5 cm. by 1.5 cm. by 0.8 cm. It is firm in consistency and brown in color. On the cut surface it is a homogenous light tan.

Microscopic: Sections of the lymph node reveal some distortion of architecture, but the follicular structure is intact. The germinal centers are large and surrounded by large numbers of lymphocytes. These lymphocytes have obscured the normal medullary structure by their large aggregations. There is also obliteration of the subcapsular rims and infiltration of the capsule by these lymphocytes. In the pericapsular tissues are also seen numerous plasma cells. This lymph node presents sufficient atypical qualities to warrant continued observation of this patient with subsequent rebiopsy if necessary.

Diagnosis: Hyperplasia of cervical lymph node.

The patient was examined in the Department of Laryngology, Rhinology and Otology on February 28, 1947, where some enlargement of the left tonsil was noted. Unilateral enlargement of a tonsil in an adult is highly suspicious of malignancy. Removal of the left tonsil for histopathological examination was recommended.

On March 3, 1947, a left tonsillectomy was performed. The pathologic findings were:

Gross Examination: The specimen consists of an irregular, firm mass of white tissue measuring 3 cm. by 2.5 cm. by 2 cm. One surface is nodular and the other is relatively flat and shaggy.

Microscopic: There is a squamous epithelial surface overlying a very cellular connective tissue stroma. The cells are oval with deep pink cytoplasm and round, dense, blue nuclei. Frequently cells with no visible cytoplasm and large round nuclei with many clumps of deep blue chromatin and an occasional nucleolus are seen. A few eosinophils and plasma cells are seen. There are rare collections of large, oval nuclei in abundant pink cytoplasm that resemble giant cells.

Diagnosis: Lymphoblastoma.

The clinical conclusion was primary lymphoblastoma of the left tonsil with metastatic extension to the left cervical lymphatic chain.

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The patient was referred to the Department of Roentgenology for radiation therapy. She received 2,200 roentgens in twelve treatments through a 6 cm. by 8 cm. portal to the left cheek and sub-mandibular area, and 1,900 roentgens in ten treatments through a 3 cm. cone to the left tonsillar fossa.

Our final examination was performed on April 11, 1947. There were only questionably palpable nodes remaining in the left cervical area. It was our opinion that these nodes were the result of radiation fibrosis, and that the disease process was controlled. Because the patient was moving to another community, she was given an abstract of the clinical and pathological findings and therapy obtained. She was also referred to a tumor clinic in the new community for observation and management.

SUMMARY

Cervical nodes were noted by the patient a few days prior to January 7, 1947. Although she was under competent medical care and a clinical impression was indicated on February 7th, a clinical diagnosis was not made until February 28th, nor confirmed until March 3rd. Her physicians felt that the interval between the appearance of the cervical nodes and the diagnosis was too long, despite several factors which tended to obscure the picture. It was natural for the gynecologist to seek an explanation for the adenopathy on the basis of the original pathology. When this proved to be unassociated with the new condition, the patient was referred to others for survey of her various organ systems. The original complaint referable to the groin and the swelling in that area raised the question of a more generalized lymphadenopathy despite the first impression that the swelling was not due to lymph node enlargement. The hematological survey minimized this possibility.

The benign character of the initial biopsy caused a considerable delay in establishing the diagnosis. The other causes of cervical adenopathy had to be ruled out despite the impression that malignant neoplastic disease was present.

While it is true that unilateral cervical nodes should be considered firstly as malignant and secondly as metastatic, this does not hold for malignancy of mesenchymal origin, in which the primary focus may occur in the connective tissue elements of the neck.

Lymphoblastoma particularly may be seen as both primary and metastatic lesions in the cervical lymph node chain. In this particular case the tonsillar asymmetry was small enough to escape the attention of the first examiners. The discovery of the primary lesion was most important from a therapeutic standpoint. Treatment of a metastasis in the presence of an untreated and active primary lesion is an empty gesture.

CONCLUSIONS

1. Various disease entities may occur concurrently and successively, and the presence of one should not obscure the possibility of others.
2. Because of the importance of time in relation to salvability, the possibility of cancer must be excluded before attention is directed to the more innocuous disease entities.
3. A negative biopsy does not exclude the possibility of malignant neoplastic disease.
4. The diagnosis of lymphoblastoma in the cervical area requires the most painstaking survey of the nose and throat, particularly of the area of Waldeyer's ring, to determine whether the lesion is primary or metastatic.

104 SOUTH MICHIGAN AVENUE.

XXII

HISTOPLASMOSIS OF THE LARYNX

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Histoplasmosis is a systemic disease with varied local manifestations. It was first described by Darling¹ in 1906 as a general infection caused by a protozoön and producing pseudotubercles in the lungs with focal necrosis in the liver, spleen and lymphnodes. It is of interest to laryngologists when lesions appear in the larynx as the differential diagnosis must be made between histoplasmosis and carcinoma, tuberculosis, syphilis and the various fungus diseases. In a review of 73 cases of histoplasmosis, Parsons and Zarafonitis² reported ten instances of granulomatous and ulcerative lesions occurring in the larynx, usually in association with lesions of the pharynx. During the past year two cases have been observed at the Jefferson Hospital and are presented here for addition to the literature. An additional case was reported by Curtis and Grekin¹⁰ in which there was a nodule present on the epiglottis. This, however, was believed to be cystic in nature and there is no proof that it was due to histoplasmosis.

REPORT OF CASES

CASE 1.—W. Z., a 38-year-old white male cook, when first seen in the Bronchoscopic Clinic complained of hoarseness of eight weeks' duration, soreness, pain on swallowing, loss of weight and a nonproductive cough. There was a history of pneumonia several years previously and about two years before admission the patient fainted while lifting a heavy weight. He noted weakness since that episode. The Wassermann and Kahn tests were negative. The blood count on admission was hemoglobin, 78% (12 gm.); erythrocytes, 3,900,000; and leucocytes, 6,800.

From the Departments of Laryngology and Broncho-Esophagology and Clinical Pathology, Jefferson Hospital, Philadelphia, Pennsylvania.

Examination of the mouth revealed a centrally elevated lesion on the dorsum of the tongue about 2 cm. in diameter, with a necrotic appearing center. On mirror laryngoscopy an extensive ulcerated, infiltrating process was seen involving both sides of the larynx including the vocal cords and ventricular bands, and producing fixation so that the airway remained large even on phonation. Roentgen study of the chest gave no evidence of recent infiltration but suggested an uncoiled aorta or possibly an aneurysm of the ascending aorta. Direct laryngoscopy exhibited a granular infiltrated mucosa, suggesting a tuberculous process. A biopsy was done and secretions were collected for examination for acid-fast bacilli. The biopsy was reported as a chronic granulomatous process; no acid-fast bacilli were found in the secretions.

An examination two months later showed a progression of the pathologic process in the larynx. The sputum and tracheal secretions again were negative for acid-fast bacilli and roentgen examination of the chest revealed normal findings. Scrapings from the lesion on the tongue produced a growth on Sabouraud's agar resembling *Monilia albicans*. The patient was admitted five days later with a history of black tarry stools, weakness with vertigo and vomiting of a large quantity of dark blood. Supportive measures were carried out. The intermittent bleeding from the gastrointestinal tract was treated symptomatically. Esophagoscopy again revealed a normal esophagus and secretions from the bronchus were again reported as containing *Monilia albicans*.

The laryngeal process appeared to be progressing. The lesion on the tongue had increased in size and had become more deeply ulcerated. A histoplasmin skin test gave a negative result. A tuberculin skin test also was negative.

A direct laryngoscopy two months later showed marked destruction of the epiglottis in addition to the previously described changes, and because of difficult and painful swallowing it became necessary to insert a feeding tube. Later, as the patient's general condition became progressively worse, a gastrostomy was done. He died six months after admission to the clinic.

Necropsy Findings. At necropsy the body was emaciated, weighed approximately 90 lbs. and measured approximately 66 inches in length. There were several circumscribed shallow ulcers on the palate, the dorsal surface of the uvula and pharynx. The ulcers measured approximately 1 cm. in diameter. Their edges were slightly

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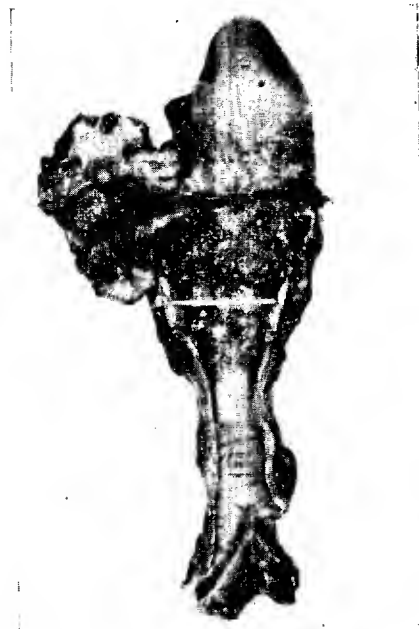


Fig. 1.—The dissected tongue, pharynx, larynx and trachea of Case 1 showing the destructive ulcer. Note the almost complete destruction of the epiglottis and vocal cords. The ulcers in the latter position are filled with a thick, grayish white, granular exudate.

undermined and their bases were pinkish gray, granular and covered with a grayish white membrane. A gastrostomy opening in the left upper quadrant admitted one finger into the stomach.

The heart weighed 390 gm. A spherical, dark tan, hard, granular growth measuring 1.8 cm. by 0.8 cm. by 0.6 cm. was present on the ventricular surface of the anterior aortic cusp. The lesion cut with resistance. The cut surface was dark brown, dry and granular and contained areas of calcification. The aortic ring measured 14.5 cm. and the ascending aorta was moderately dilated. Its intimal surface contained irregular atheromatous plaques. The left ventricle measured 1.7 cm. in thickness. The coronary arteries were patent.

The mucosa of the base of the tongue, pharynx, larynx and upper one-fourth of the trachea were involved in a destructive ulcerated lesion. The epiglottis and vocal cords were completely

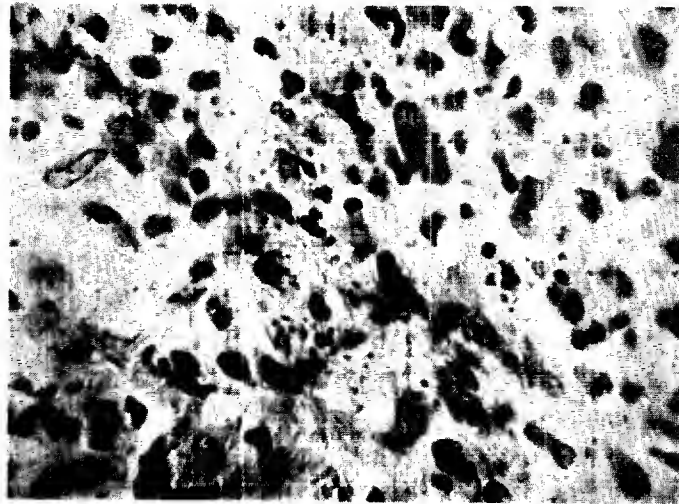


Fig. 2.—Photomicrograph of section of the larynx showing the *Histoplasma capsulatum* singly and in clusters within the cytoplasm of the large cells of the granuloma (x 900; oil emersion).

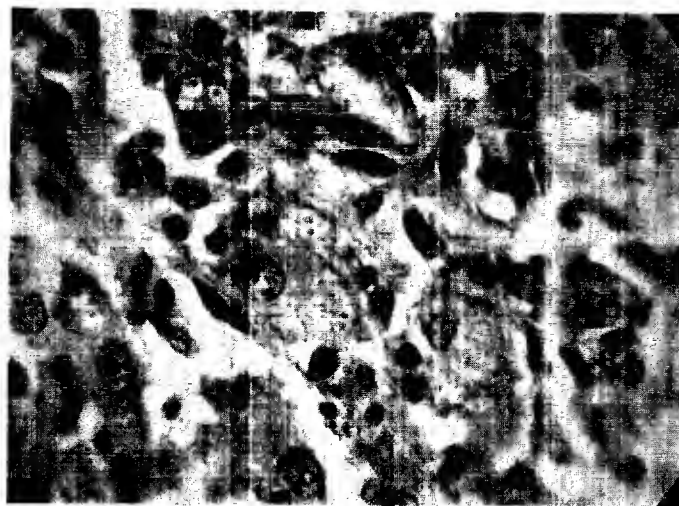


Fig. 3.—Photomicrograph of section of the biopsy of the larynx in Case 2. The *Histoplasma capsulatum* are readily identifiable in the cytoplasm of the monocytes by the clear capsule (x 900; oil emersion).

destroyed. The raw surfaces were irregular, grayish pink, firm and granular. Several deep ulcers involving the trachea eroded portions of the first and second tracheal rings. The ulcers were covered with a thick gray, tenacious exudate and the edges were irregular and undermined (Fig. 1). The left lung weighed 640 gm. and the right 420 gm. They were crepitant and mottled pinkish gray and black.

The spleen weighed 180 gm. A firm, depressed area measuring 2.5 cm. by 2 cm. by 1.5 cm. was evident along one border. Its cut surface was homogeneously orange and rubbery in contrast to the surrounding dark red, fleshy parenchyma.

Eleven discrete and circumscribed ulcers were haphazardly distributed on the mucosal surface of the cecum and ascending colon. All were similar. They measured 5-6 mm. in diameter. Their edges were circular, clean and slightly raised. The bases were shallow, pink and granular. Several calcified lymph nodes were palpable in the adjacent peritoneal reflection. The largest lymph node measured 8 mm. in diameter.

The left kidney weighed 150 gm. A subcapsular nodule was present on the border opposite the hilus. It was raised, firm, spherical and measured 3 mm. in diameter. The cut surface of the nodule was homogeneously grayish tan.

Grossly the adrenal glands were not remarkable.

Histological sections of the pharynx, larynx, colon and both adrenal glands disclosed similar granulomatous lesions containing clear bodies which morphologically resembled *Histoplasma capsulatum*. The granulomas were composed of numerous plasma cells, macrophages, fibroblasts, lymphocytes and giant cells with an eosinophilic cytoplasm. The clear bodies were short, straight or slightly curved and dark, each surrounded by a clear zone measuring approximately 3 micra in diameter. They were found either singly or in clusters within the cytoplasm of the macrophages (Fig. 2).

The lesions of the aortic valve, spleen and lymph nodes were amorphous, fibrous and calcified material.

Pathologic Diagnosis: (1) Systemic histoplasmosis with granulomatous lesions of the pharynx, larynx, colon and both adrenal glands; (2) left ventricular hypertrophy; (3) dilatation of the ascending aorta; (4) healed ulcerative endocarditis with calcification of the aortic valve; (5) atherosclerosis of the aorta; (6) pleural

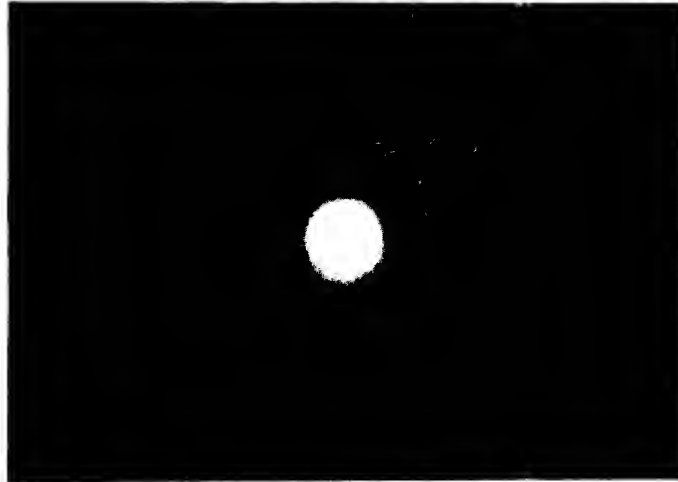


Fig. 4.—Twenty-eight-day-old colony of *Histoplasma capsulatum* on Sabouraud's glucose agar showing the fluffy, white cottonball appearance,



Fig. 5.—Photomicrograph of smears from the colony in Fig. 4 stained with lactophenol cotton blue stain showing the characteristic large, round, thick walled, tubercle chlamydospores as well as the septate hyphae bearing the small, smooth, pyriform spores ($\times 900$; oil emersion).

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adhesions of the left pulmonary apex; (7) healed splenic infarct; (8) calcified mesenteric lymph nodes and (9) adenoma of the left kidney.

No successful cultures of *Histoplasma capsulatum* were obtained from the necropsy material.

A re-examination of laryngeal biopsies secured antemortem disclosed lesions similar to those found at necropsy, but the clear bodies resembling *Histoplasma capsulatum* were found only rarely after prolonged search.

CASE 2.—I. J., a 28-year-old negro housewife, complained of hoarseness of three weeks' duration. When first seen in the clinic, the hoarseness was severe, nearly to the point of aphonia. There was no history of either vocal abuse or acute respiratory infection. She gave a history of short periods of hoarseness in the past which had responded to gargles and other self-administered medication. A mirror examination of the larynx showed fixation of the vocal cord in abduction and a large polypoid mass on the upper surface of the left vocal cord at the junction of the anterior and middle thirds.

The patient was admitted to the medical service of Professor Hobart A. Reimann one week later because of a severe productive cough and dyspnea in addition to the hoarseness. The personal medical history revealed that seven years previously, following the birth of her first child, she noticed the appearance of raised lesions upon her left arm which later appeared on both upper and lower extremities, face and trunk. A biopsy of one of the skin lesions was diagnosed as sarcoidosis. She had been followed in the medical outpatient department since that time as a case of sarcoidosis. Roentgen studies of the chest had shown a progressive widening of the hilar areas and the presence of diffuse homogenous nodular shadows in both lung fields. The Wassermann and Kahn tests were consistently negative. The blood count on admission revealed hemoglobin 78% (12 gm.); erythrocytes, 4,100,000; leucocytes, 5,400; segmented neutrophils, 66%; lymphocytes, 24%; monocytes, 6%; eosinophils, 2%; basophils, 2%. The total plasma protein was 8.27 mg. %; albumin, 3.57; globulin, 4.7. No acid-fast bacilli were seen in the sputum.

A histoplasmin skin test was found to be weakly positive in 48 hours. A first strength tuberculin skin test (P.P.D.) was positive. No histoplasma organisms were found in the peripheral blood or in the sternal bone marrow.

Direct laryngoscopy revealed an ulcerated lesion which involved the left vocal cord and extended laterally into the floor of the ventricle. Biopsy was done.

The tissue removed from the larynx consisted of six irregular pieces of grayish black tissue. The largest piece measured 7 mm. by 4 mm. by 3 mm. The tissue was firm, granular and slightly friable. The tissue was composed of many fibroblasts, macrophages, a few polymorphonuclear leukocytes and giant cells with an eosinophilic cytoplasm. No well formed tubercles were present. A few blood and lymph channels permeated the tissue. Clear bodies resembling *Histoplasma capsulatum* were found singly and in clusters within the cytoplasm of the macrophages (Fig. 3).

Following this examination the patient had a severe systemic reaction with fever, dyspnea, pleuritic pain, nausea and vomiting. This was relieved by the parenteral administration of fluids.

Direct examination of the larynx performed nine days later disclosed a recurrence of the original lesion. Additional biopsies and secretions were secured for study. These biopsies were similar both grossly and microscopically to those reviewed at the original examination. Colonies typical of *Histoplasma capsulatum* were grown on Sabouraud's agar at room temperature from the material removed by laryngeal biopsy and from laryngeal secretions. No growth was obtained on the blood citrate agar recommended by Weed and Parkhill¹³ when inoculated with the same material.

After the diagnosis of histoplasmosis was made from the laryngeal tissue, one of the subcutaneous nodules was excised for examination. The skin surface was dark, soft and wrinkled. The underlying dermis was thickened, slightly firm and grayish tan. Histologically, numerous granulomatous lesions were seen scattered irregularly in the dermis. Some of them had a solid tuberculous arrangement. The lesions were composed of the same elements, including the clear bodies, as those in the larynx.

Despite the use of various antibiotics and symptomatic treatment, the patient's course was progressively downhill. She died four months after admission.

Necropsy Findings. At necropsy the larynx was quite regular, smooth and glistening. The pertinent findings were: (1) a serous effusion of the pleura, pericardium and peritoneum; (2) bilateral

pleural adhesions involving the upper lobes; (3) grayish black granular nodules producing complete obliteration of the normal parenchymal pattern of both upper lobes; (4) shotty nodules throughout the lungs; (5) lymphadenopathy of mediastinal and abdominal nodes; (6) right cardiac dilatation; (7) congestion of the spleen; (8) a fine grayish white mottling and a few yellowish granular nodules of the liver and (9) firm white nodules measuring up to 4 mm. in both adrenal glands.

A chronic granulomatous lesion was seen histologically in the lung, lymph nodes and adrenal glands. Structures resembling *H. capsulatum* were found in the lesions of the adrenal glands. These lesions appeared to be of more recent origin than the others. The vocal cords were completely healed and showed no evidence of a granulomatous lesion.

Cultures were taken from the lesions of the larynx, lungs, lymph nodes, spleen, kidneys, liver and bone marrow, from the bronchial secretions and from fluid from the pericardial, thoracic and peritoneal cavities. They were seeded on Sabouraud's glucose agar and kept at room temperature. A fine fluffy, white cotton-ball colony grew in 28 days from the culture of the left adrenal gland (Fig. 4). The other cultures showed no growth after 60 days. Smears from the colony revealed the branching septate hyphae bearing small, smooth, round to pyriform conidia, and the large, round, thick walled tuberculate chlamydospores (Fig. 5). The latter are characteristic and establish the diagnosis.

SUMMARY

Two cases of systemic histoplasmosis with lesions involving the larynx are reviewed. The two cases were similar in a number of respects. Hoarseness was the chief complaint. The laryngeal lesions were responsible for the patients being admitted to the hospital. The larynges showed an ulcerated, granular, infiltrating lesion involving the vocal cords and extending into the ventricles. The involved vocal cords were fixed. The histologic sections revealed granulomatous lesions containing the yeast form of *H. capsulatum* within macrophages and monocytes.

The difficulty of isolating the fungus on artificial media was experienced in both cases. Seeding on Sabouraud's glucose agar kept at room temperature for at least one month was the most satisfactory technique.

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GAMMELL-BRECKENRIDGE

The histoplasmin skin tests were either negative or weakly positive. The adrenal glands were involved in both patients.

Present day antibiotics were unable to combat the infection. It was believed, however, that they may have been responsible for the disappearance of the laryngeal lesions in the second case.

CONCLUSIONS

1. The larynx may be involved in systemic histoplasmosis.
2. Laryngeal lesions are ulcerating, granular, infiltrating lesions causing fixation of the vocal cords.
3. Hoarseness is a common symptom when the larynx is involved.
4. The diagnosis may be made by histologic sections or cultures from laryngeal lesions, preferably early lesions.
5. Cultures on Sabouraud's glucose agar kept at room temperature for at least one month is a satisfactory method of isolating *H. capsulatum*.
6. At present there is no known cure for systemic histoplasmosis.

123 SOUTH TENTH STREET.

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XXIII

STREPTOMYCIN IN ACUTE HEMATOGENOUS
MASTOIDITIS DUE TO BACILLUS PROTEUS

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AND

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REPORT OF A CASE

A 32-year-old negro was hospitalized on November 30th, 1948 for examination of aurai discharge. The discharge was profuse and the ear painful. The patient gave a history of having had a severe sore throat for the previous seven days, with painful swelling along the sides of the neck. Early in the morning of the day before admission, he was awakened by a severe pain deep in the left ear, with chills and fever. Some five hours later, a profuse bloody colored discharge began to flow from the left ear. Pain in the ear increased and the discharge continued until the evening of the next day, at which time he presented himself at the hospital.

Upon admission, he had a temperature of 102° F., a pulse rate of 80, and a normal respiratory rate. Physical examination indicated infection of the ear, nose and throat and otolaryngological consultation was requested.

Examination of the throat showed a severe tonsillitis and pharyngitis. There was marked follicular pharyngitis. The larynx was negative except for a slight redness of the arytenoids. The septum was deflected to the left. There was some evidence of bilateral anterior ethmoiditis, more pronounced on the left. There was a generalized hyperemia of the nasal mucosa. The right ear was negative. From the left there was profuse drainage, sanguineous and slightly purulent.

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The left ear was cleansed gently with dry cotton until the drum was seen. It was markedly cyanotic. There was a white exudate over the greater part of the drum, and some necrosis in the posterior central area. Pulsations were visible.

The fluid in the middle ear was also sanguineous and purulent. There was tenderness over the mastoid bone, more pronounced just over the antrum.

X-ray films taken the day after admission were interpreted as follows: The right mastoid is normal in appearance. The left mastoid shows diffuse clouding of the cellular structures, consistent with acute mastoiditis.

Cultures from the blood and from the exudate produced a pure growth of *B. proteus*.

Since streptomycin is known to be effective in arresting this strain, 0.5 grams were given every six hours. Within 48 hours the temperature returned to normal. There was no longer any tenderness over the mastoid bone and the drainage had diminished. At the end of five days there was only a slight discharge. The landmarks of the ear drum were now distinguishable; there remained a perforation in the posterior central portion.

Streptomycin was discontinued on the seventh day; the ear was then almost entirely dry. X-ray films taken on the seventh hospital day showed a marked clearing of the mastoid cells. Blood cultures taken on the third and fifth day were sterile. Other laboratory findings were essentially negative.

COMMENT

This case illustrates the rapid effectiveness of streptomycin in an acute attack of *B. proteus* mastoiditis, with septicemia. Early diagnosis of a gram-negative type of infection, whether due to *B. proteus* or *H. influenzae*, permits streptomycin to be used; it has been proved most effective when used early. Especially in cases of mastoiditis is this a factor, since complications arise during a delayed course of treatment. In this case blood cultures taken early in the course of the disease gave an accurate and quick index to the severity of the infection.

Clinical findings associated with a gram-negative bacillus infection as seen in this case were typical; they are, cyanosis of the tympanic membrane usually with an adherent exudate on the drum; sanguineous discharge from the middle ear; rapid progression of changes in the ear drum from the time of onset; early onset of mastoiditis following upon otitis media (in this case 48 hours); evidence of an associated acute infectious process, usually in the throat.

SUMMARY

A case of *B. proteus* otitis media, and mastoiditis, associated with blood stream invasion, is presented. The value of early diagnosis and criteria of diagnosis in *B. proteus* infections of the ear is discussed. The patient had a quick, uncomplicated recovery.

GALLINGER MUNICIPAL HOSPITAL.

XXIV

NONTRAUMATIC ANEURYSM OF THE FIRST PORTION
OF THE RIGHT VERTEBRAL ARTERY ASSOCIATED
WITH VOCAL CORD PARALYSIS

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Aneurysms of the cervical portion of the vertebral artery which are reported in the literature are, for the most part, of traumatic origin.¹⁻⁴ The following is a case of nontraumatic aneurysm of the first portion of the right vertebral artery associated with paralysis of the right vocal cord.

REPORT OF A CASE

A 57-year-old male was first seen at the Vanderbilt Clinic of Presbyterian Hospital, New York, on January 17, 1947, complaining of hoarseness of two months' duration. His previous health had always been good except for a tonsillectomy in 1920, an appendectomy 1937, and a left nephrectomy for stones and infection in 1937. He had never been told he had hypertension. In 1945 he noted the gradual onset of sharp pain in the right lower anterior cervical region which radiated through to the back of the neck. Near the point at which the pain originated he became conscious of a small swelling about 2 cm. in diameter which remained the same size until his admission to the hospital. At the same time, he began to tilt his head slightly to the right in order to improve his vision. Two months before visiting the clinic the patient developed a slight hoarseness which progressed rapidly so that he was unable to continue his work as restaurant cashier. Also during those two months he had become aware of a feeling of coldness in the right anterior cervical region when he swallowed food and fluids. There was no difficulty with swallowing otherwise.

Physical examination showed a well developed, well nourished male of 154 lbs. who did not appear ill. The temperature, pulse,

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and respirations were normal. The blood pressure was 190/120. The patient spoke in a whispered tone. The eyes externally, and the fundi, were normal. There was slight fulness in the region of the right lobe of the thyroid; on inspection and on palpation, a 2-cm. rounded mass which was soft, movable, and slightly tender, appeared to be located in the upper portion of the right lobe of the thyroid. There was no thrill or bruit, and no pulsation was detected. The trachea was deviated slightly to the left. Laryngoscopy showed a fixed right vocal cord. Physical examination was negative except for a right lower quadrant midrectus scar and a left flank scar.

Laboratory Findings. The Kline reaction was negative. A postero-anterior film of the chest appeared normal except that the tracheal air column was deviated slightly to the left in the region of the seventh cervical and first thoracic vertebrae. An x-ray film of the esophagus showed no diverticulum nor neoplasm, and no evidence of tracheal compression.

The patient was referred to physiotherapy for galvanic stimulation of the larynx twice a week and after eight treatments showed no improvement. On March 11, 1947, he was admitted to the Presbyterian Hospital for further study. Physical examination was the same and laryngoscopy again showed the paralyzed right vocal cord with no abnormality of the trachea and hypopharynx. An x-ray film of the cervical spine in the postero-anterior projection demonstrated a slight irregularity along the right border of the tracheal air column in the laryngeal and subglottic regions. There was also a very slight demineralization of the transverse process of the seventh cervical vertebra on the right. The lateral view showed the soft tissue space behind the trachea in this same region to be wider than is usually seen. Laminagrams demonstrated no abnormality in the contour of the vocal cords or ventricles and the right sided vocal cord paralysis was not seen. The complete blood count was normal. The specific gravity of the urine was 1.020; no albumin was present and the microscopic examination was negative. The serum cholesterol was 362 mg.%. The basal metabolic rate was -12%.

It was the opinion of the neurological consultant that there was no abnormality other than the vocal cord paralysis. Partial thyroidectomy was recommended because of the single firm nodule in the thyroid. The patient's symptoms along with the physical finding of deviation of the trachea and the x-ray findings could not be satisfactorily explained on the basis of the small nodule.

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Operation. On March 25, 1947, an anterior low collar incision was made elevating the upper flap of skin and platysma, incising the deep fascia in the midline vertically and retracting the strap muscles laterally. The 2-cm. firm to hard nodule in the upper pole was located, but no other disease could be found in the entire gland which was of normal size, color and consistency. After completely mobilizing the right lobe of the thyroid except for its lower pole, a moderate anterior bulge in the region of the transverse process of the seventh cervical vertebra was noted with considerable overlying scar tissue reaction, brownish discoloration and slight edema of the fascia. Further exploration revealed this to be a 2-cm. by 2½-cm. nonpulsating mass. This proved to be an aneurysm of the right vertebral artery which was excised after ligating the artery above and below the sac. At the point of ligation flush with the transverse process of the sixth cervical vertebra the vessel was of normal size. The nodule in the upper pole of the right lobe was removed. The recurrent laryngeal nerve was not identified and exploration of the left side showed no abnormality to suggest another vertebral artery aneurysm. The pathological specimens removed demonstrated the aneurysm to be for the most part saccular and containing an organized blood clot. No endothelial nor epithelial lining was present. The thyroid nodule was composed microscopically of follicles of varying size associated with an increased fibrous tissue framework surrounding areas of involution and, at one point, a rather large cyst lined by columnar epithelium.

The postoperative course was uneventful and the patient was discharged on April 1, 1947. The first follow-up visit was on May 2, 1947, when the patient reported that the preoperative complaint of sharp pain in the anterior cervical region radiating to the back of the neck had disappeared two weeks after operation. He continued to hold his head tilted slightly to the right. His voice continued to be a whispered tone and the vocal cord paralysis on laryngoscopy was unchanged. On June 24, 1947, the patient still had hoarseness and complete paralysis of the vocal cord. On January 20, 1948, ten months postoperatively, the patient noted that for the past two weeks his voice had improved markedly so that there was now some volume. Laryngoscopy showed the right vocal cord to be fixed. On April 1, 1948, the voice continued to improve gaining more volume. X-ray films of the spine in stereoscopic anteroposterior and right lateral projections and films in both oblique projections demonstrated that the very slight demineralization of the right transverse process of the seventh cervical vertebra persisted. The soft tissue space between the trachea and the anterior vertebral column was

definitely smaller than seen on the films one year previously and was now considered to be of normal dimensions. The slight irregularity on the right side of the tracheal air column noted on the films of one year before was not reproduced. By August 17, 1948, the voice was normal but the right vocal cord was still paralyzed.

DISCUSSION

The symptoms of pain, a feeling of coldness on swallowing, and the hoarseness plus the physical finding of deviation of the trachea and the x-ray findings of slight irregularity along the tracheal air column, slight demineralization of the transverse process of the seventh cervical vertebra and the widening of the soft tissue space between the trachea and the anterior air column could not be attributed to a small nodule in the right lobe of the thyroid. Obviously an aneurysm could not have been suspected preoperatively. The chief indication for operating on this patient was the single firm nodule and the possibility that more disease was present than could be appreciated clinically. If the right lobe of the thyroid had not been completely mobilized the aneurysm might well have been missed at operation. The return of voice to normal was apparently due to compensation of the interarytenoid muscle. It is probable that the paralysis of the vocal cord was due to involvement of the recurrent laryngeal nerve in the scar tissue overlying the aneurysm. When relieved, pressure on the recurrent laryngeal nerve may result in a return of function in a period of approximately eight to ten months. The persistent paralysis of the vocal cord suggests that the nerve may have been irreparably damaged preoperatively or partially excised or transected at operation. The relief of symptoms along with the return to normal of all the changes seen by x-ray film except the slight demineralization of the transverse process of the seventh cervical vertebra strongly suggest that they were on the basis of the aneurysm and not the small thyroid nodule. The etiology of this aneurysm is unknown and in view of a minimal degree of arteriosclerosis its explanation on the basis of hypertension appears unlikely.

CONCLUSIONS

A case of a small nontraumatic aneurysm of the first portion of the right vertebral artery associated with vocal cord paralysis is reported. The aneurysm was not detected by physical examination and the abnormalities noted by x-ray examination, while definite, were not of sufficient degree to suggest a diagnosis. Perhaps if the

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case had been seen earlier before a clot appeared in the saccular portion of the aneurysm, a bruit might have been heard. It is suggested that this possible etiology be considered in case of vocal cord paralysis where no obvious cause is apparent.

622 WEST 168TH STREET.

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XXV

LOCATION AND REMOVAL OF BROKEN
NEEDLE IN TONSILLAR FOSSA

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In the course of an operation as frequently performed as that of tonsillectomy accidents are prone to occur. Guarding against aspiration of a tooth, sponge, tonsil tissue or blood clot is the constant concern of the surgeon and anesthetist. Snare wires are not infrequently broken. When the small portion that has been bent upward to fit into the eye of the stylet gives way, the possibility of its entrance into the tracheobronchial tree is very great.

The local anesthesia needle and the needle used to suture bleeding vessels in the tonsillar fossa may not only be aspirated when broken but also lost as a foreign body embedded in the tissues.

The problems presented by the breaking of a suture needle in the tonsillar fossa have been aptly discussed by Weiss¹. Aside from his article, little has been written on this subject. He collected a series of 67 cases of broken needles—57 suture needles and 10 injection needles, from 34 operators.

There appears to have been too great a tendency to minimize the possible deleterious effect of leaving the broken needle in situ. Frequently patients have not been told of the accident, a dereliction which raises the possibility of malpractice risks. Serious complications as a result of failure to remove the broken fragment have included painful swallowing, glossopharyngeal neuralgia, parapharyngeal space infection and migration of the needle into the deep tissues of the neck.

Many operators have shunned the use of the suture ligature in the control of bleeding tonsillar vessels because of the risk involved. It is certain that thin needles should not be trusted in this region. Stout, round needles that have been properly tempered and not bent by previous misuse should be chosen for this work. The ligature

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carrier type attached to a handle as a single unit is safer for use in the tonsillar fossa because, if broken, the catgut threaded in the eyelet will serve to extract the broken fragment.

When confronted with such an accident and if the broken segment is not readily found, the operator, usually having had no previous experience to draw upon, must improvise. The head should be immediately lowered to guard against further descent of the broken fragment. Obviously, the hemorrhage must first be completely controlled. If the needle is not readily seen or felt, Weiss advises transferring the patient to the x-ray department, where the general anesthesia is continued. A suction machine is also made available. The fluoroscope is used to locate the needle and if it is found to have descended into the tracheobronchial tree, bronchoscopic removal should immediately follow. If revealed in the tonsillar fossa roentgenograms should be taken for the record. Weiss then introduces a Flagg type of laryngoscope to raise the tongue and allow inspection of the tonsillar fossa, hypopharynx, pyriform fossae and larynx. If the needle is not then located he introduces a slender-jawed tonsillar hemostat into the fossa. He employs a hand fluoroscope to guide him in the further manipulation of the forceps, attempting thereby to find the embedded needle. When it reaches the needle, the hemostat is closed on the fragment. The needle may then be extricated with the same forceps or with the aid of another placed in juxtaposition to facilitate removal.

Unfortunately, this accident is more commonly encountered in the practice of general physicians, first because they perform the majority of tonsillectomies and again because they are apt to be less proficient in the use of suturing instruments.

In the instances where I have been called upon to remove a broken needle the accident had occurred hours or days previously at the hands of general physicians. There existed the added disadvantage of being forced to rely on another's recollection of the possible site of entrance of the needle. In both instances this was later proven to be misleading. Although the original operator assisted in both procedures, the needles were actually finally located quite remote from the positions originally designated.

Under such circumstances it would be wise for the consultant to have at his disposal a means of more accurately localizing the foreign body. Otherwise haphazard searching will needlessly trau-

matize the already infected tonsillar fossa. Digital palpation and the use of the electromagnet were not helpful in my hands. Although I have not had the occasion to try it, the Alnico² magnet would probably prove no more effective. The Berman³ localizer, if available, could also be used. The ordinary anteroposterior and lateral roentgenograms of the face and neck were not of practical value in localization.

As will be noted in the case reports which follow, I was able to extract the needle in the first case after considerable dissection and search in a plane at right angles to the indicated position of the needle. In the second case, after two unsuccessful attempts, I succeeded in withdrawing the fragment after more accurately localizing its position in the tonsillar fossa by use of an ordinary rubber catheter inserted through the nose into the pharynx.

REPORT OF CASES

CASE 1.—A female aged 25 had had her tonsils removed by a general surgeon, under ether anesthesia. Three days previously, while an attempt was being made to suture a bleeding vessel in the right tonsillar fossa near its upper pole, the thin needle broke and could not be found. X-ray films showed the needle embedded in the tissues. The next day, following infiltration of the fossa with 1% procaine, I employed an electromagnet but did not succeed in delivering the needle. I then used blunt dissection in a plane at right angles to its long axis and, after considerable effort, was able to extract it.

CASE 2.—A female aged 16 had a tonsillectomy performed by a general practitioner, under ether anesthesia. Because of persistent postoperative bleeding during most of the day, she was removed to the operating room at one o'clock the next morning and reanesthetized. The bleeding was found to originate from the right tonsillar fossa. After clamping the bleeding point, the operator attempted to insert a curved needle held in a needle holder but the needle broke and the fragment could not be located. The patient was kept under the anesthetic pending my arrival 45 minutes later. Although I searched diligently for over 30 minutes in the region of the upper pole near the posterior tonsillar pillar, where the operator

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Fig. 1.—Lateral x-ray film showing broken suture needle in the region of the tonsillar fossa.

stated he had lost the needle, I did not succeed in locating it. X-ray films later that morning showed the fragment to be in the region of the tonsillar fossa (Fig. 1).

After infiltrating around the fossa with 1% procaine, I again utilized blunt dissection over a wider area near the upper half of the posterior pillar, but failed to recover the needle.

The hospital roentgenologist was consulted for advice about a possible method of more accurate localization of a pharyngeal foreign body, for by this time I questioned the accuracy of the operator's recollection as to the probable site of lodgment. The roentgenologist could offer no assistance other than the use of the usual x-ray positions. It then occurred to me that an ordinary urethral catheter inserted into that side of the pharynx by way of the nostril of the same side might help in localization.



Fig. 2.—Anteroposterior x-ray film showing broken suture needle in relation to a catheter placed adjacent to the posterior tonsillar pillar. Before this aid the needle had been searched for at the upper extremity of the posterior pillar. Following this x-ray, the needle was found about 2 cm. lateral to the posterior pillar as demonstrated by this film.

Since it is well known that the catheter will lie in close contact with the posterior pillar, knowledge of the position of the broken needle in relation to this landmark would be extremely valuable.

Repeat roentgenograms with the catheter in place revealed the needle to be at a considerable distance lateral to the posterior pillar. This indicated that my two previous efforts had been fruitless because I had searched for the fragment at a site at least 2 cm. distal from its actual location (Fig. 2).

The following day I again infiltrated the tonsillar fossa with 1% procaine. The electromagnet failed to dislodge the broken fragment. I next employed blunt dissection in the region of the

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anterior pillar, the probable site of the foreign body, as indicated by the x-ray films taken with the catheter in the oropharynx. With minimal effort, I then succeeded in locating and extracting the needle.

Because of its simplicity I offer this as a practical aid worthy of trial in any case where a needle has been broken in a tonsillar fossa and help in its localization becomes necessary. X-ray films taken with the catheter adjacent to the tonsillar fossa will not only show the needle but will also help to localize its approximate point of lodgment, which the usual films will fail to do.

Davison⁴ similarly succeeded in localizing a needle by inserting a skin clip into the tonsillar fossa. This method should be valuable but the possibility of adding another foreign body accident to the one already existing might deter some from utilizing it.

It has occurred to me that a combination of the catheter and skin clip method will combine the advantages of each and eliminate the danger of foreign body aspiration. After the catheter has been inserted, its tip may be withdrawn through the oral cavity and a skin clip firmly attached to it. Another clip may be similarly placed, say, about one inch above the tip. The catheter with the clips attached may then be withdrawn into the oropharynx, its dependent tip being placed opposite the lower tonsillar pole. The external portion of the catheter may then be firmly anchored to the cheek with adhesive tape.

X-ray films will then show the position of the broken needle in relation to the posterior pillar as well as to the upper and lower tonsillar poles.

During the operation for removing the broken needle the catheter with its landmarks may be left in place as additional guides.

CONCLUSIONS

When called in consultation to extract a broken needle lost in a tonsillar fossa, the larynologist should first employ a method of localization before attempting its removal.

The placement of a rubber catheter through a nostril into the pharynx will, by virtue of its juxtaposition to the posterior tonsillar

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pillar, help to localize the needle on the x-ray films. Further help in localization may be obtained by attaching one or more skin clips to the catheter.

Haphazard, blind dissection and use of the electromagnet have proven ineffective in extracting needle fragments embedded in pharyngeal tissue.

METROPOLITAN BUILDING.

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XXVI

OTITIC HYDROCEPHALUS

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AND

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Otitic hydrocephalus has been described as intracranial hypertension complicating otitis media or mastoiditis, with normal cerebrospinal fluid. The fact that these symptoms of intracranial hypertension with normal cerebrospinal fluid can occur as the result of other than otitic lesions renders the term otitic hydrocephalus somewhat inaccurate. However, as stated by Williams,¹ the term, while not completely accurate, serves to keep otologists on the alert for its presence with otitis, and is therefore generally useful.

The most prominent and constant finding is papilledema, which in some cases may become very marked. Headache is usually present, but varies in location. Photophobia is a very frequent finding and vomiting, nystagmus, stupor and blurred vision may also be present. Symptoms may occur at any time during the infection, and not infrequently they occur when the patient is well on the road to recovery.

The etiology remains obscure. Whether the primary disturbance is one of increased secretion or decreased absorption has not definitely been established. It nearly always occurs in young people, predominantly in children and adolescents.

Brain abscess is probably the most often suggested diagnosis by the symptomatology, and is generally the most difficult to differentiate. Differential diagnosis may require diagnostic surgery or ventriculography. Acute lymphocytic meningitis is frequently simulated, especially if the increased pressure is associated with otitis. Cerebral tumor, encephalitis and aseptic meningitis have to be considered.

Read before the College of Physicians, December 18, 1948.

Treatment varies with individual cases. Many will spontaneously clear shortly after the first diagnostic lumbar puncture. Others may be more persistent and this procedure must be repeated, sometimes as often as twice daily. When the process is severe, the improvement slow and there are signs of beginning permanent optic damage, decompression, sometimes bilateral, may be necessary.

REPORT OF A CASE

G. U., a 27-year-old white male, was admitted on June 14, 1947, complaining of an acutely painful right ear. He had received a disability discharge from the army in March, 1944, because of recurring drainage from the right ear since 1940, which was accompanied by episodes of pain and deafness.

The present illness began on June 10, 1947, with a gradual onset of pain and blocking in the right ear. The symptoms progressed and he developed swelling and tenderness in the preauricular region and below the right ear. The pain increased in severity and spread to the right side of the neck and right temple. It was accompanied by generalized headache. Upon admission his temperature was 100° F. and he looked toxic. There was no complaint of nausea, vomiting, vertigo, diplopia or stiff neck.

Examination revealed tenderness over the right mastoid and a tender swelling in front of the ear and over the zygoma. The external auditory meatus was completely closed by painful swelling of the canal, from which came a scant foul-smelling purulent discharge. The membrana tympani could not be seen. Except for the right ear, the physical examination was negative. The white blood count was 16,600 with 82% polymorphonuclear leukocytes. Culture of the aural discharge showed *Bacillus proteus*, hemolytic *Staphylococcus aureus*, and *Streptococcus faecalis*. X-ray films revealed marked sclerosis of both mastoids but no evidence of bone destruction. Skull plates were negative.

He was given penicillin (100,000 units every three hours) and sulfadiazine (4 gm. initial dose and 1 gm. every four hours) upon admission, to which was added 0.5 gm. streptomycin every four hours when the report of the ear culture was received. His fever, headache and toxemia increased and on June 20th the temperature reached a peak of 104° F. (rectal) accompanied by chills. No clinical signs of meningeal irritation were noted, but lumbar puncture revealed

a pressure of 375 mm. of water. The spinal fluid was clear. There were four cells per cubic millimeter present. The chemical examinations were normal. The Tobey-Ayer manometer test was negative. Examination of the eyes on June 21st showed no abnormality. The fundi were normal, and there was no evidence of papilledema.

On June 21st a right mastoidectomy was performed under endotracheal anesthesia. The mastoid was small and sclerotic with areas of necrosis throughout, especially marked at the tip and in the region of the antrum and extending forward into the zygomatic area. The sinus plate was necrotic. The lateral sinus was exposed for about one inch and its wall found to be markedly thickened and inflamed. Because of the likelihood of a thrombus being present, the internal jugular vein was ligated in the neck and the lateral sinus was incised. A partial thrombus was evacuated and the sinus packed. A blood culture taken at the time of operation was reported as showing an anerobic streptococcus and an anerobic gram-negative bacillus. Culture from the mastoid cavity showed an anerobic streptococcus, anerobic gram-negative bacillus, and *Bacillus proteus*. He had a chill immediately following operation, and his temperature was 104° F. (rectal). His headache was severe, requiring 1/16 of a grain Dilaudid every two hours for relief.

On the second postoperative day spinal puncture showed a pressure of over 600 mm. of water. After removal of 25 cc. of spinal fluid the pressure dropped to 220 mm. and the headache, which was pronounced before the tap, was greatly relieved. The spinal fluid was clear. Twenty-one white blood cells per cubic millimeter were present and culture of the fluid showed no growth. Neurological examination at this time was negative. Localized infection in the neck occurred at the site of the jugular ligation, and on June 28th the skin over the area was opened and about 50 cc. of foul-smelling pus was evacuated, the culture of which showed a gram-negative bacillus, later identified as *anerogenic paracolon*.

He gradually became afebrile. The mastoid and neck wounds healed, and on August 19th he was discharged from the hospital. The spinal fluid pressure at that time was still high, measuring 450 mm. of water. Examination of the eyes was again negative with no signs of papilledema.

Following his discharge from the hospital the patient returned to his work as a painter, but he did not feel entirely well. He tired

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easily and had the sensation of objects whirling when he stood up from a sitting position or turned his head to the left. He also had mild intermittent headaches. He had no somnolence, ataxia, nausea or vomiting. The mastoid wound was slightly tender. The ear was dry.

On November 5th the mastoid wound began to discharge purulent material and he was readmitted to the hospital the following day. He said he felt better when the mastoid began to drain.

Physical examination upon the second admission revealed discharge from the inferior portion of the right mastoidectomy wound and the right external auditory canal through a perforation in the inferior portion of the membrana tympani. The neurological examination was negative. Lumbar puncture made on November 7th showed a pressure of 380 mm. of water. The fluid was clear of cells and chemical examination was normal. Examination of the eyes on November 11th revealed bilateral enlargement of the blind spot; 3 diopter elevation OS, 5 diopter elevation OD, engorged veins, arteriovenous nicking, peripapillar exudate, macular edema and flame shaped hemorrhages bilaterally. The diagnosis given by the ophthalmologist was papilledema secondary to increased intracranial pressure probably due to abscess in the right temporo-sphenoidal lobe.

He was examined by the neurosurgical consultant the same day who stated that an abscess of the right temporo-sphenoidal lobe should be ruled out. Skull films were obtained and were reported as normal. On November 18th an electroencephalogram was done and found to be normal. That afternoon he was operated upon by the neurosurgeon. The brain was exposed by a right temporal bur hole. It was described as "wet" and the intracranial pressure was obviously increased. The brain was punctured in five directions with a trocar, but no pus was found. A right subtemporal decompression was carried out. Following the decompression the probable diagnoses suggested were (1) encephalitis secondary to the mastoiditis or (2) brain tumor.

On December 15th, approximately one month following the decompression, the papilledema was reduced to 1 diopter OD and 2 diopter OS. The veins were only slightly full, and no hemorrhagic nor fresh exudates were observed. On December 19th the spinal fluid pressure was 300 mm. of water. On January 6, 1948, a combined

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lumbar-ventricular air encephalogram was done. The only abnormality found was a slight shift of the lateral ventricle to the side of the decompression. Following this, a diagnosis of otitic hydrocephalus was made.

On February 21, 1948, the mastoid was reopened. A moderate amount of granulation tissue was found in the region of the antrum. This area was curetted, but the middle ear was not disturbed. The mastoid wound healed, and the ear became dry and has remained so to date.

On February 10, 1948, the spinal fluid pressure was 290 mm. of water and examination of the eyes showed papilledema of 1.5 diopter OD, and 0.5 diopter O.S.

He was discharged from the hospital on February 26, 1948, asymptomatic.

Examination on December 18, 1948, revealed cerebrospinal fluid pressure of 230 mm. of water and normal content. The eye grounds showed pigmentary disturbance of the right macula, and vision of 20/50 in the right eye. There was no measurable papilledema.

1830 SPRUCE STREET.

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XXVII

FRONTAL SINUS INFECTIONS—
COMPLICATIONS AND MANAGEMENT

CLAUDE D. WINBORN, M.D.

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After the introduction of the first antibiotics, the management of infections in general, and infections of the respiratory tract in particular, has been constantly revised. Only a few years ago, osteomyelitis or an intracranial complication of the frontal sinus was expected to terminate fatally or undergo extensively mutilating surgical treatment. In the past three or four years much evidence has appeared in the literature that survival can be expected in intracranial complications, and extensive bone removal is not necessary when antibiotics and judicious surgical approaches are employed. The purpose of this report is to add further material of statistical value to the literature.

By far the most frequently seen complication of frontal sinus disease is an osteolytic process of one or both of the tables, or osteomyelitis of the skull plate in the vicinity of the infected sinus. Most of these extensions have occurred in recurrent infections or in patients with a history of local trauma from weeks to years previous to the onset of the disease.

Fortunately, bone disease of the frontal sinus is usually accompanied by tenderness and swelling over the sinus involved. The patient has a headache, fever, and usually appears ill, and the cause is suspected early. The swelling may be in the forehead near the midline in which case it extends from the eyebrow up to or even above the hair line, or there may be a swelling of the upper eyelid from an involvement in the floor of the sinus. In many cases these two areas are involved simultaneously. Lethargy or progressive stupor is not present, but there may be signs of meningeal irritation. X-ray studies are of value in the early stage only in establishing the

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diagnosis of acute sinusitis, since the first signs of an osteolytic process will not show up until the sixth to tenth day.

There is perhaps no other condition in which more harm can be done with insufficient or improper use of antibiotics than in sinus infections. Some cases to be presented will illustrate this. The fault may lie either with the physician who first sees the patient or the patient's unwillingness to comply with recommended instructions. Often there has been considerable intracranial extension of the infection by the time the patient reaches the specialist. Diagnosis is made difficult by the lack of localizing symptoms, and the infection appears simply as a sinus that will not clear up or an abscess that continues to drain. Extradural abscess or empyema can easily be present under these conditions, since with extradural abscesses the illness is apparently mild. There are no signs of increased intracranial pressure and there may not be meningeal irritation. Even a frontal lobe abscess may be developing during this period.

Intracranial extension in most cases is prevented or arrested by beginning a high dosage of antibiotics and draining the abscesses when they develop. When a bone infection of the frontal sinus is first suspected, 50,000 to 100,000 units of penicillin is given intramuscularly every three hours accompanied by 1 gm. of sulfadiazine every four hours. Heat has been found useful in localizing abscesses of the forehead or in the upper eyelid. The patient is observed closely, and if an abscess develops it is drained promptly. Trephining of the sinus is not necessary in every case. After the beginning of adequate treatment there usually follows a period of progressive improvement during which the temperature falls, the white blood count decreases and the patient feels more comfortable. X-ray studies are made every two or three days in order to watch the progress of the disease.

Conservatism should be continued if possible until the infection is well under control. If improvement is delayed, drainage of the sinus should be established through a trephine opening in the floor. Favorable cases will completely heal with a clear sinus and recalcification of the necrosed area after simple drainage and continued administration of antibiotics. The other cases must be treated by some type of external surgical approach. Any frontal sinus with a residual diseased lining is a potential danger to the patient and should be operated.

Where there is much involvement of either table of the frontal sinus the Lynch operation is seldom found to be an adequate approach, and some modification of the Killian procedure must be used. If satisfactory response has been obtained from the antibiotics, the infection will be in a quiescent stage and it will be sufficient to remove the diseased epithelium from the sinus along with the grossly involved bone and establish a wide nasofrontal duct. The administration of antibiotics should be continued from two to three weeks following the operation.

Extradural collections of pus seldom produce any symptoms independent of osteomyelitis, and unless there has been previous x-ray evidence of these abscesses, they are discovered at the time of operation. If no perforation through the posterior table is found, it should be customary to make one before closing the sinus in order to inspect the dura, since meningeal involvement occasionally occurs without gross bone changes. A perforation of the posterior table may be open or filled with granulations which, when followed, lead to a well localized abscess. The perforation should be enlarged to provide adequate drainage. All pus is aspirated, and a rubber tube is inserted through to the posterior wall of the abscess with the other end extending out through the skin wound. Aspiration and irrigation with penicillin are carried out daily. The drain is removed on the second or third day after the drainage has stopped. Follow-up x-ray films should be repeated until there is definite assurance that the sinus has healed and infected areas in the frontal bone which were not removed have formed definite sequestra, or until recalcification is complete.

Subdural empyema and brain abscess are often difficult to differentiate. Both may develop from an acute or chronic sinusitis, although more cases of subdural empyema have been reported to follow acute infections. Both usually accompany osteomyelitis, but a brain abscess more often develops by retrograde thrombosis than does a subdural empyema. As a rule the slowly developing brain abscess may be so mild as to go unnoticed until expansion is considerable, but the rapidly forming abscess can produce a picture much like a subdural empyema. There are symptoms of increased intracranial pressure with the development of a variety of lateralizing signs. The patient has fever, meningeal irritation and lethargy, usually accompanied by convulsions, either jacksonian or generalized. Spastic or flaccid hemiparesis may develop in some cases, usually on the contralateral side. Cloudy spinal fluid under pressure and

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papilledema add to the picture of intracerebral hypertension. A brain abscess is less likely to cause convulsions and hemiparesis. Both may terminate in septic meningitis. The diagnosis of subdural abscess is confirmed by opening the dura through a trephine opening. Whereas a subdural abscess is usually acute and follows a recent frontal infection, a brain abscess may occur weeks or months following an infection which may not have been apparent to the patient. Depending on the rapidity of the expansion of the abscess, the symptoms may vary from those of a chronic illness, headache, loss of appetite and weight, and listlessness to a rapid fulminating type with lethargy, irritability and focal brain symptoms similar to those found with subdural empyema but as a rule not as prominent. Convulsions may occur on the contralateral side but are usually followed by paresis of the lower branches of the facial nerve, then later of the arm and leg of the contralateral side.

The treatment for each is extensive drainage and eradication of the infected focus in the frontal bone. Subdural empyemas are opened through the posterior plate as well as through bur holes and thoroughly irrigated with penicillin solution. Penrose drains are placed under the dura in many directions. If extension is considerable, additional bur holes are made and additional drains placed. The space is irrigated with penicillin solution at frequent intervals until the infection is cleared. Frontal lobe abscesses are drained preferably through the frontal sinus, particularly if a continuous tract is present through the posterior table, but they may be drained through an aseptic bur hole or bone flap. A rubber tube drain is placed in the abscess and carried out through the skin wound for aspiration and irrigation with penicillin. In all complications the administration of penicillin and sulfadiazine is begun early and continued until danger of recurrence is passed.

REPORT OF CASES

CASE 1.—A white male about 30 years of age was admitted in March, 1947, with severe frontal headache and swelling in the forehead. He had been struck on the head with a stone while in the service in 1943, and shortly thereafter complained of frontal headaches but received no treatment for them. In the winter of 1946 his headaches became worse, and in April, 1946, he developed an acute frontal sinusitis with osteomyelitis of the frontal bone. He was given antibiotics, and an operation was performed by a neurosurgeon who removed some osteomyelitic bone in the frontal area and drained

an epidural abscess. Apparently the frontal sinus was not inspected at that time. He had no further complaints until March 1, 1947, when the process of headache and swelling of the forehead recurred.

On admission there was a low grade fever and a mild leukocytosis. The swelling was over the right forehead, and a defect about 2.5 cm. in diameter could be palpated in the frontal bone above the sinuses in the midline. X-ray examination showed an osteolytic process in the anterior table in the superior medial angle of the right frontal sinus and adjacent frontal bone. The patient was given penicillin and sulfadiazine. By the twelfth day the acuteness had subsided and an external frontal operation was performed. The lesions present were essentially a confirmation of the x-ray findings with a marked hyperplasia of the sinus lining and considerable purulent exudate. Most of the anterior table was removed along with the necrosed bridge of bone connected with the previous operative defect. The dura was normal in appearance and no epidural extension was found. Recovery was uneventful and there had been no recurrence up to November, 1948.

If the involvement of the frontal sinus had been given attention at the time of the first operation, it is believed that the second episode would not have occurred. Apparently identical symptoms were present on both occasions, and the second operation should have been done following the first attack.

CASE 2.—A 15-year-old boy had an acute right pansinusitis six weeks previous to admission, at which time he had a subperiosteal abscess in the forehead which had been treated elsewhere by incision and drainage concurrently with penicillin and sulfadiazine administration. X-ray films at that time demonstrated a right pansinusitis with involvement of the maxillary sinus. Because the abscess continued to drain, it was reopened at intervals and penicillin in oil given infrequently. This procedure was carried out only a week prior to admission. He was admitted on April 22, 1948, at which time he was afebrile and the blood count was essentially normal. X-ray films of the sinuses demonstrated a rarefaction involving the medial upper extremity of the right frontal sinus and extending further up into the frontal bone in the midline. Another area of rarefaction was present high in the frontal bone and separated from the first by apparently normal bone.

The patient was operated upon the afternoon of the day of admission. An I-shaped incision was made extending across the

right eyebrow and vertically in the forehead to the left of the draining sinus, which was present at the site of the original incision. A perforation was found in the outer table of the right frontal sinus through which pus was exuding. The whole anterior wall was removed, exposing a sinus filled with granulations and pus. A perforation of the posterior plate was filled with granulations, and was found to overlie a large epidural abscess extending along the longitudinal sinus. This abscess contained about 60 cc. of thick pus from which were cultured alpha and beta hemolytic streptococci. The diseased bone in this area was removed, the frontal sinus operation was completed and the epidural abscess drained by a rubber tube extending out through the skin wound. Penicillin irrigation of the abscess cavity was carried out daily. The cavity was free of exudate on the sixth day and the tube was removed on the eighth day. He remained afebrile but received penicillin and sulfadiazine until the day of discharge. He had one cold in June, 1948, but the frontal sinus was not involved appreciably. X-ray films taken on October 11, 1948, showed a resorption of the untreated osteomyelitic process in the frontal bone but very little recalcification.

Undoubtedly the posterior table in this case was involved when the patient was first treated, but the seriousness of the symptoms went unrecognized by the practitioner. Certainly the use of antibiotics was erratic and without sound judgment.

CASE 3—A 13-year-old boy who was admitted on December 9, 1947, gave a history of having run into a brick wall three weeks before. He had no unusual symptoms at this time, but three days later he developed headache, vomiting, nuchal rigidity, and fever which reached a peak of 106° F. In another hospital he was given penicillin injections. Other physical findings at that time are not known, but apparently his symptoms cleared up as he was discharged on the sixth day. At home he soon began having fever again, and once had a slight convulsion and was kept in bed. Three days before admission he again complained of headache and noticed a swelling on his forehead.

Physical findings on admission were limited to a suppurative pansinusitis and a bilateral otitis media. The temperature was 104.4° F. but there were no signs of intracranial involvement. X-ray examination of the sinuses on admission showed a diffuse clouding of all the sinuses with an apparent erosion of the superior medial extension of the left frontal sinus, which was not conclusive

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of osteomyelitis at this time. There was no evidence of a skull fracture. He was placed on high dosage of penicillin and sulfadiazine. Three days later, on December 12th, a subperiosteal abscess was drained in the forehead. At that time he was comfortable, alert and afebrile. X-ray films of the sinuses on December 16th definitely demonstrated an osteomyelitis in the area which was previously involved. He continued to improve and was discharged on January 2nd, apparently cured. X-ray films taken two months ago showed that he had completely recovered.

This was an instance of a complete cure by simple drainage of an abscess and antibiotics. The patient must have had an acute sinusitis at the time of his injury with the development of meningitis by continuity. If penicillin had been continued long enough at that time, he probably would not have developed the bone infection.

CASE 4.—A 26-year-old male truck driver struck his head on a door three weeks before admission on June 15, 1946. Apparently he was not seriously injured as he continued to work. Three days later he noticed a small tender area over his right forehead and began complaining of frontal headache and pain in his eyes. He grew progressively worse, the forehead and left eye began swelling and he developed a cough with hemoptysis. On admission the patient was acutely ill. The temperature was 103.4° F., pulse rate 140, and white count 38,000 with a marked shift to the left. The swelling over his right forehead was large and fluctuant. The left eye was proptosed, fixed, and the pupil moderately dilated. A tentative diagnosis of orbital cellulitis, osteomyelitis of the frontal bone and lung abscess was made and antibiotics were started.

On opening the abscess of the forehead a large amount of pus which was later reported to contain a staphylococcus, was encountered. X-ray films showed extensive osteomyelitis of the left frontal sinus and the frontal bone with clouding of both frontal and maxillary sinuses and the left ethmoidal sinus. X-ray examination of the chest revealed multiple metastatic pulmonary abscesses. He was placed on penicillin and sulfadiazine and given supportive treatment and several transfusions.

On June 21st the left frontal sinus was opened through the floor and a moderate amount of pus, which also contained staphylococcus, was aspirated. Both plates were intact but there was a perforation of the intersinus septum which communicated with the

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right frontal sinus. On removing the septum the right sinus was much like the left. A rubber tube drain was placed through the floor of the sinus so that irrigation could be carried out with penicillin solution. An exploration of the left orbit was negative for localized abscess. Following the sinusotomy the temperature decreased to 99° F. and the patient showed a rapid clinical improvement. He refused a radical sinusotomy and was discharged on July 18th after 33 days hospitalization, with the administration of sulfadiazine to be continued for another month. A recent re-examination after two years showed him to be clinically cured.

It is conceivable that this patient was in danger of recurrence because a radical frontal sinus operation was not performed, but he has been well for over two years since his illness. Apparently drainage and antibiotics were adequate to completely clear this staphylococcal infection.

CASE 5—A 23-year-old white male was admitted on August 22, 1948. His illness apparently began in the first part of February, 1948, when he fell off a diving board and was unconscious for five minutes. By the latter part of that month he began having a dull right frontal headache with chills and fever. He was hospitalized in his home town for ten days. He improved and was discharged, but the headache continued with increasing severity. Later, he began vomiting and complaining of pain in the right occiput. At this time there was some peri-orbital swelling. He was hospitalized again and given penicillin. The peri-orbital swelling cleared up and he was discharged. The treatment was continued by specialists for several weeks, but his headache was not relieved. On August 18th he staggered and fell in the street. He remained in bed after this but developed a urinary incontinence and a spasm of the right arm.

On admission there was tenderness over the right coronal suture and bilateral papilledema with a mild proptosis of the right globe. He was semiconscious and not oriented to time or place. He soon became comatose and developed a paresis of the left arm and leg. The neurosurgeon established a diagnosis of brain abscess by finding the cavity through a trephine opening in the right parietal bone. X-ray films showed what appeared to be a sequestrum in the right frontal sinus. The sinus was opened and an erosion with a sequestrum was found in the posterior wall. The frontal lobe abscess was opened through this window by perforating a markedly thick capsule by electrocautery. A perforated rubber catheter was inserted into

the cavity and sutured in place. Treatment was continued by aspiration, penicillin irrigation and the administration of penicillin parenterally. It was estimated that the abscess contained 160 cc. of pus from which a streptococcus was cultured.

Recovery has been progressive with few residual findings at the time of this writing. The paresis has completely disappeared, the papilledema is resolving and the sensorium is practically normal. This patient will be watched for many weeks for signs of recurrence.

An apparent point of interest in these five cases, and seven others that have been observed in the past three years, is that an osteolytic process in either table of the frontal bone, whether diagnosed by x-ray or at operation, has always occurred medially at or near the superior extension of the sinus. Such an observation has not been found in the literature.

SUMMARY

1. The principal complications of frontal sinus infections and their management have been discussed and five representative cases presented.
2. Extensive surgery is not necessary and mortality is low in frontal sinus complications when these are treated conservatively in conjunction with penicillin and sulfonamides.
3. When the quiescent stage is reached following a complication, a chronic frontal sinus should be exenterated by an external approach in order to avoid a possible recurrence.

MEDICAL ARTS BUILDING.

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XXVIII

FOREIGN BODY (TWIG) IN THE NOSE

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The following case is deemed worthy of report because of the mildness of the complaints and the suspected gravity of the lesion.

On November 21, 1947, Mrs. R. K., white, aged 46, complained that for the past six months she had awakened with mild discomfort just above the bridge of the nose. This would last only a few hours. For several months, she had had slight nasal breathing difficulty in the morning only, for a few hours. There was a soreness on the left side of the nose of one month's duration, with slight tenderness, but there had been no purulent or hemorrhagic discharge at any time.

Examination of the nose revealed a widening in its mid-portion and more especially to the left side, which the patient stated had existed for a "long time". There was tenderness at the site of the swelling on the left side and the skin was freely movable over this area. Intranasally, the right side was entirely normal. The left side was occluded by a mass in the region of the middle turbinate, impinging against the left side of the septum and completely blocking the olfactory sulcus. The under surface was necrotic in appearance and the remaining surface was of the same color as the nasal mucous membrane. On manipulation with the applicator, the under surface bled easily and some loose, foul, necrotic tissue was removed. The maxillary and frontal sinuses transilluminated normally. From the above clinical examination, malignancy of the nose was suspected.

The report of the x-rays taken the same day stated: "Stereoscopic, postero-anterior, lateral, and vertical views of the nose show extensive osteolytic destruction of the distal half of the left nasal bone. There is also marked fragmentation and irregularity of the lower margin of the left maxillary plate of the nose. The septum is deviated to the right and there is a definite soft tissue mass occu-

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pying the left nasal cavity. There is no evidence of involvement of the walls of the sinuses or orbits. Impression: A malignancy with destruction of the left nasal bone must be given first consideration."

A biopsy was performed under local anesthesia and several specimens were removed. There was free bleeding and much foul necrotic tissue. Some purulent material escaped. The biopsy report on November 25, 1947, was as follows: "Seven sections each of two masses, both about 8 mm. in diameter, show mucous membrane with numerous glands, moderate edema and round cell infiltration, with plasma cells and eosinophils predominating in many places. Fibrin deposits are evident in some of the edematous areas. There are occasional small hemorrhages. Some parts of the surface and glandular epithelium are altered: the cells are closely packed and elongated, and in places the epithelium is stratified squamous in type. All of the altered epithelium appears to be within the basement membrane. No definite malignant change is observed. Final diagnosis: Nasal mucosa with allergic (?) inflammation. Areas of metaplastic and alloplastic epithelium."

The serological report for lues was negative.

On November 28, 1947, a second biopsy was performed. While anesthetizing the left side of the nose, an elongated necrotic area was observed on the under surface of the mass. Believing this to be a sequestrum of bone because it felt firm, its removal was decided upon and an instrument was used to fracture it downwards. This was done and there was free bleeding. When the field was cleared the necrotic mass was grasped and pulled out of the nose. It was a thin, firm object, covered over large portions of its surface with calcium deposit and necrotic foul tissue. On washing and cleaning the foreign body, it was found to be a twig about four inches long, and bent upon itself for one inch at one end. It was about $\frac{1}{8}$ of an inch in thickness except where the calcium deposits increased the calibre.

The duration of the presence of the foreign body in the present case can only be conjectured. It must have been a period anywhere between 8 to 12 years because of the following history. Between the years 1935 to 1939, the patient was in an asylum for the insane, because of a severe involutional melancholia following a hysterectomy. The insertion of the foreign body most likely occurred during those years at the asylum because the patient has been perfectly normal since 1939 and because she recalls that while in the asylum

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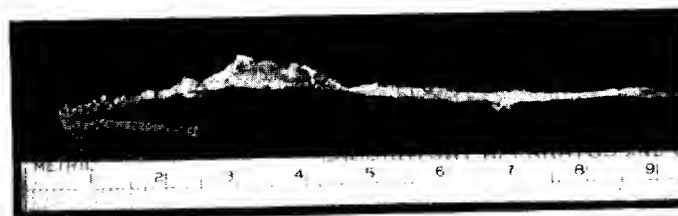


Fig. 1.—Foreign body (twig) in the nose.

she was taken to the operating room for the removal of another foreign body, namely a bead, from one of the ears.

The rapidity of recovery, that is, the return to normal anatomical appearance and function was most amazing. Striking improvement was observed in three days and within seven days there was almost complete return to normal.

The literature on foreign bodies in the nose of long standing was reviewed, and several cases were found where objects were in the nose for as long as 13 to 28 years.

Worthington¹ reported a piece of stick with bark on it removed from the nose after 13 years. The symptoms were fetid discharge during that period.

Kelemen² reported a case in a 34-year-old white male of a piece of wood from the tip of an umbrella, lodged in the right half of the nose for 28 years. It became partially calcified and was expelled spontaneously with mild local inflammatory signs through a perforation of the nasal wall at the level of the inner canthus.

Camerer³ reported a foreign body in a 22-year-old seaman who had no symptoms or totally disregarded them despite the fact that his nose had been host to a calcified cork for 17 years.

Donnelly⁴ reported the presence of a metal screw in the nose of a child for two years without any perceptible discharge or odor.

10515 CARNEGIE AVENUE.

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New Instrument

XXIX

A NEW SELF-RETAINING RETRACTOR FOR USE IN ENDAURAL SURGERY

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AND

HENRY L. WILLIAMS, M.D.

ROCHESTER, MINN.

In endaural surgery, especially in the fenestration operation, maintenance of a relatively bloodless field is extremely desirable. Although manual use of retractors gives superior exposure, which can be altered to suit the exigencies of the moment, few assistants are able to maintain the desired immobility during a long operation. As a result of relaxation of tension on the retractors from time to time, excessive bleeding is promoted.

Several models of self-retaining retractors were tried, but proved to be unsatisfactory because of the indifferent exposure they afforded. Finally, one of us (Gooch) designed and had constructed a self-retaining retractor which we believe combines the desired immobility with good exposure of the operative field (Fig. 1).

When this retractor is used, only one modification of the usual Lempert incision is necessary. This consists in the making of superior and inferior scissor cuts in the membranous canal after the three primary incisions of Lempert, followed by elevation of the integument, have been made. The making of these two incisions in the membranous canal releases tension, so that the pull of the retractor does not dislodge the membranous canal from the bony external auditory canal prematurely (Fig. 1).

The retractor is made so that by turning it over it may be used for either the right or left ear.

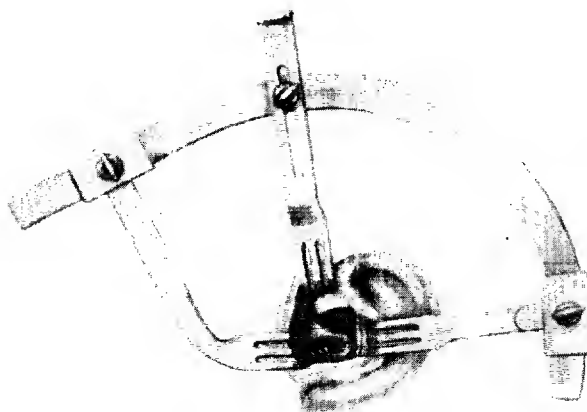


Fig. 1.—The Gooch self-retaining retractor for otodaural surgery applied to the left ear.

The open portion of the arc of the retractor is placed ventrally. The retractor is applied in the closed position. The posterior claws are first placed under the periosteum covering the mastoid portion of the temporal bone. The anterior claws are then placed under the periosteum covering the squama temporalis and the temporal muscle lying immediately cephalad to the tragus. The claws are then separated to a distance which affords the desired exposure and are locked in position by thumbscrews. A third claw is then placed under the temporal muscle, which is drawn upward. This claw is then attached to the retractor by a suitable thumbscrew and is fixed in place.

This retractor has now been thoroughly tested at the operating table and has given us satisfaction. We feel that it is a definite improvement over the other self-retaining retractors which we have had an opportunity to examine.

MAYO CLINIC.

Society Proceedings

CHICAGO LARYNGOLOGICAL AND OTOLOGICAL SOCIETY

Meeting of Monday, November 1, 1948

THE PRESIDENT, DR. WILLIAM A. SMILEY, IN THE CHAIR

Food Allergy as a Cause of Myalgia of the Posterior Cervical Muscles

THEODORE G. RANDOLPH, M.D.

(by invitation)

(Abstract)

Localized muscular reactions manifested by pulling, drawing, tightness, aching and "knotty" sensations in the posterior cervical muscles are commonly observed in the allergic patient during the course of individual food tests (Rinkel's technic) for the specific diagnosis of food allergy. The fact that such symptoms may be induced experimentally or relieved following avoidance of specific allergenic foods is the basis for the thesis that they are, at least sometimes, of allergic origin.

During the past century, the descriptive features of this syndrome have been described by Valleix, Norstrom, Halle, Edinger, Mithoefer, Seydell and Williams. Both the last named associated these symptoms with the allergic patient, but Rowe (1931) was the first to demonstrate that they might be reproduced as a part of the allergic reaction.

Chronic myalgia of the posterior cervical region is one of the most common localized allergic manifestations involving muscle groups. This condition is much more frequent than represented by the complaints of patients, as originally pointed out by Seydell. It also may or may not be associated with headaches, chronic fatigue and other constitutional or localized allergic manifestations.

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In a few instances, acute torticollis, or "wryneck", has been demonstrated to be on a similar mechanism. The most favorable circumstances for the development of such an acute reaction include the presence of a high degree of specific sensitivity to a commonly ingested food which previously has been avoided for at least three or four days prior to an evening meal. This is usually associated with an allergic reaction of such severity as to cause the individual to retire shortly after the meal. Acute, localized pain, most commonly involving the insertion or body of the trapezius, develops suddenly as a result of turning in bed during the night, upon arising in the morning or within the first half hour after arising. Contracture of the involved muscle with immobilization of the head in a position favoring shortening of the affected muscle or muscles immediately results because of the extreme pain associated with any motion of the head. Attacks vary in severity and may persist for four or five days.

Although muscular symptoms of allergic origin have been demonstrated to be most commonly on the basis of chronic food allergy, a few instances have been observed where similar symptoms are on the basis of sensitivity to house dust.

DISCUSSION

DR. ROBERT LEWY: I do not recall that Dr. Randolph said anything about the use of antihistaminic drugs either from a diagnostic or a therapeutic point of view. I would like to know what his experience has been with them, and how this may alter the dietary restrictions a patient might otherwise have to undergo.

DR. SAMUEL SALINGER: I am sure that Dr. Randolph's paper merits a great deal of discussion. Much of what he has said has been borne out in our clinical experience, particularly one fact which he pointed out, namely, that skin tests for food sensitivity have been uniformly disappointing. Rhinologists get these cases primarily because of frontal headaches which the patient assumes to be due to sinus infection. The associated muscle pains at the back of the neck may not be stressed, but are brought out when the full history is obtained. I have never associated this condition with food sensitivity and am very much interested in Dr. Randolph's findings. I would like to ask whether, in the absence of favorable skin diagnostic procedures, and with so many commonly ingested foods coming under suspicion, it is not a rather difficult and complicated procedure to determine just which item is the offender.

I would also like to mention Dr. Williams' article on "Physical Allergy" in which he described this condition, and in which favorable results were obtained following administration of nicotinic acid. We have encountered a number of cases fitting this description, and have found that the injection of histamine or hapamine in ascending doses has yielded excellent results in many patients. A number of authors have assumed the condition to be due to the local release of histamine due to an allergen.

DR. THERON G. RANDOLPH (closing): The position of the antihistaminic drugs in diagnosis and treatment of allergic disturbances is not yet fully established. On the whole, I have been disappointed with them but doubt if I have seen a representative group of cases, because patients referred to us, as allergists, have usually been treated previously by means of such medications and by the time we see them they are quite willing to settle down and work out their allergic problems specifically. Consequently, we are inclined not to use these measures as freely as do many physicians outside our field, who are searching for some palliative measure or short cut to the detailed diagnostic measures. In those patients receiving various antihistaminic preparations I have not been particularly impressed with their efficacy. Although in some cases they seem to reduce the severity of allergic symptoms, they do not ordinarily afford a satisfactory degree of relief in the food-sensitive patient. As a consequence, I find that I prescribe these drugs less and less frequently, except in those instances where for one reason or another we are unable to diagnose the case specifically.

With respect to the question of difficulty of diagnosis of food allergy in view of the number of foods involved, ordinarily, if one knows the reaction as a result of individual food tests with the first half dozen foods in the patient's diet (that is, the foods he is eating most frequently and consistently) one can usually work out the remainder of the diet around these facts. At this point one will know whether the patient has a wide base or a narrow base of food sensitivities. If only one or two of these tests are associated with symptoms, the patient is judged to have a narrow base of sensitivity and is placed on a sharply restricted diagnostic elimination diet, including the test-compatible foods but omitting the test-incompatible foods and all others high in dietary incidence. If he is found to have a wide base of sensitivity, reacting with clearcut symptoms to many of the foods checked individually, he is in-

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eligible for a restricted type of diagnostic diet because this type of patient readily becomes sensitive to any food placed in his diet in oft-repeated feedings. Such patients have been observed to develop new sensitivities in as short a time as five days. In this type of case the diagnostic program is prolonged; one must appraise individually the next six or eight most commonly ingested foods until a test-compatible diagnostic diet is found.

I failed to mention Dr. Williams in giving the background of this clinical syndrome. His work published in 1944 associated this type of reaction with the physical allergy syndrome. He quoted some of the earlier observations of Sluder and pointed out that some patients respond to histamine treatment. Although histamine therapy may be tried in these cases, it frequently fails. I see a new patient about every ten days who has been through a course of histamine "desensitization" without effect and who is currently willing to work out his problem specifically. I think, perhaps, the experience of some of you might be better in this respect than is mine because you are seeing patients firsthand with this complaint. If you have good results with histamine therapy there is no reason why you should not continue it.

The Problem of the Acoustic Neuroma

ERIC OLDBERG, M.D.

(by invitation)

(Abstract)

The subject of the acoustic tumor up to its present day status is fully reviewed. After a historical survey, including early descriptions of the tumor, primarily diagnostic contributions, and early surgical mortality statistics, the matter of modern understanding of symptomatology and surgical attack is brought up to date. The dilemma of whether it is better to risk recurrence by subtotal extirpation, or to risk higher operative mortality, disfigurement, and prolonged disability by an attempted complete extirpation, is discussed.

DISCUSSION

DR. SHERMAN L. SHAPIRO: This topic has perennial interest for us, if for no other reason than most of us are always wondering when we are going to overlook one of these lesions when it is in the

otologic phase. To put the matter quite plainly, as Dr. Oldberg said, diagnosis after the tumor has grown out of the internal auditory meatus is fairly easy; but a diagnosis while it is still in the internal auditory meatus is quite difficult. The fact is that even if we have a unilateral deafness, with a history of tinnitus and loss of vestibular function, we still cannot undertake a practical diagnosis of acoustic tumor in the otologic phase unless we can see erosion of the internal acoustic meatus in the x-ray film, because there are other conditions that can cause loss of both vestibular and cochlear function. Then, too, we all know cases in which erosion of the internal acoustic meatus occurs late, if at all, depending upon the consistency of the tumor.

Something might be said about the otitic findings. First of all, let us consider the matter of spontaneous nystagmus. There is an irritative phase of the tumor. I am not sure that I have ever seen it. It must be short, and the nystagmus which we generally see, which is persistent, is obviously due to irritation of the vestibular nuclei and cannot be considered as an early sign. The otitic symptoms, as Dr. Oldberg implied, like other symptoms will depend upon the consistency of the tumor; in other words, you see cases with hearing quite well preserved where the tumor is soft, and vice versa. The so-called cerebellar pontine angle syndrome, that is, loss of function on the other side with the head upright or 30 degrees forward, of the so-called vertical canals and, of course, loss of vestibular function on the same side, I have rarely seen, and I doubt its practical value in diagnosis. I think it should be looked upon as an intracranial pressure symptom, possibly upon the vestibular nuclei. By the time that is manifested I think you will note so many findings relative to the other cranial nerves that the diagnosis is fairly well apparent.

A point in differential diagnosis: The chronology here, as I think Dr. Oldberg brought out, can be of help. In a typical acoustic tumor I think tinnitus and hearing symptoms must come first. Several years ago I presented some case reports to this Society; one was a typical acoustic tumor from our clinic, another was an oligodendroglioma. There were present at the end all the findings, but the tinnitus and hearing loss were not first. That, I believe, has some bearing on the prognosis, because we are likely to think of that type of tumor as originating from elsewhere in the cerebellar pontine angle rather than the sheath of the acoustic nerve.

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Some 40 years ago Panse devised a method for operating on these tumors by a translabyrinthine route; that is still being done in Germany. As recently as 1938 Guttich reported 12 cases with an operative mortality of three. He attempts complete extirpation and, of course, the facial nerve goes, and he admits that the technic is not aseptic; he had one case of meningitis. I do not see how large tumors could be removed that way, but I believe it could be done by an otologist who was accustomed to operating on the labyrinth.

I would like to ask Dr. Oldberg whether, if really early diagnosis of such a tumor could be made it would affect the result materially. I also want to say that I have enjoyed hearing this résumé from one who was, as the audience knows, one of Dr. Cushing's most able pupils.

DR. WALTER H. THEOBALD: I want to commend Dr. Oldberg on this excellent presentation. I think, after hearing this, it would be fairly easy to diagnose an acoustic tumor. As otologists we are probably seeing these cases much earlier than neurosurgeons do, perhaps in conjunction with a neurologist who sends them to us to get an acoustic picture. It is true there are varying degrees of deafness and tinnitus and the case must be observed over a period of years before we can be anywhere near certain about an acoustic tumor.

I would like to ask Dr. Oldberg whether he attaches any importance to x-ray examination of the internal meatus, and whether he finds any information from that source; is it helpful in early diagnosis?

DR. ERIC OLDBERG (closing): In reply to Dr. Shapiro's question whether early diagnosis would influence the convalescence of these patients and permit easier removal of the tumor, I may say that it would, very much.

Dr. Theobald asked whether or not x-ray study was important in early cases, particularly x-ray films of the internal acoustic meatus. Unfortunately, the films commonly show no significant erosion until the tumor is quite large. That is no reason for not taking them, however.

It has also been asked whether or not exploration should be made of all patients who come to the otologist with the complaint

of tinnitus following increasing deafness. That is a difficult question and, theoretically, it would be nice to be able to do it. The trouble is that such an operation is a major procedure, and one likes to have a reasonable degree of certainty that he will find a surgically amenable lesion before undertaking it. To operate upon all patients with minimal symptoms and findings would be like doing an abdominal exploration for everyone who complains of a transitory stomach ache.

**The Superior and Recurrent Laryngeal Nerves:
Clinical Considerations**

LAWRENCE J. LAWSON, M.D.

(Abstract)

The vagus nerves may be involved from the cerebral cortex to the termination of their branches.

In studying the complex functional innervation of the recurrent laryngeal nerve Murtagh noted that a stimulus controlled for 1/100 of a second at 10 volts caused an abduction response, while stimulation for 1/100 of a second above 12 volts produced adduction. This study gives a logical means of understanding the dual function and opposed action of the intralaryngeal musculature.

Familiarity with the course of the right and left recurrent laryngeal nerves clarifies involvements occurring in the course of each. Paralysis of an intrinsic muscle may be due to:

A cerebral lesion only if bilateral.

A lesion in the medulla from degeneration of the nucleus ambiguus, pressure from neoplasm, or meningeal inflammatory thickening.

Destruction of motor nerve fibers in the vagus trunk or its recurrent branch from intracranial growths, or growths about the jugular foramen in the neck, or tumor growth in the thorax.

Peripheral neuritis.

Muscular diseases or myopathic palsies.

Abductor paralysis is the usual form. Only rarely can it result from cortical involvement. In the bulbar region it may result from thrombosis, hemorrhage, embolism, tumors compressing the bulb, tabes, disseminated sclerosis, syringomyelia. The more common lesions affecting the motor fibers are listed.

The superior laryngeal nerve divides into an external branch containing motor fibers to the thyroepiglottic and cricothyroid muscles, and an internal branch supplying sensation to the entire mucous membrane of the larynx.

A case is reported of cerebral tumor causing symptoms of involvement of both branches of the superior laryngeal nerve, and glottic adductor spasm indicating recurrent laryngeal irritation originating from tumor irritation of the motor cortex. Mental fogging occurred because of the left temporal lobe location.

A record is presented of an accurately located tumor having adductor spasm from cortical irritation transmitted through the recurrent laryngeal nerve; and laryngeal anesthesia and cricothyroid paralysis from impairment of the superior laryngeal nerve function.

LIONEL COLLEDGE, F.R.C.S.

1883-1948

Lionel Colledge, for many years one of the best known laryngologists in England, died on December 19th at the age of 65.

He was educated at Cheltenham College and Caius College, Cambridge, and took his medical degree at St. George's Hospital in 1910. He served in the first World War as aural surgeon to the First Army and was on the staff of several London hospitals.

For many years he was interested in malignant disease of the larynx and was co-author with Sir St. Clair Thomson of a monograph on that subject, for which he is best known in this country. He was Semon Lecturer in Laryngology at the University of London in 1927. Later, he was associated with Sir Charles Ballance in researches on nerve anastomosis for the relief of vocal paralysis.

Mr. Colledge was one of the founders of the Association of Otolaryngologists and at various times was president of the sections on laryngology and otology of the Royal Society of Medicine and editor of their Proceedings.

Abstracts of Current Articles

EAR

Meniere's Syndrome. Successful Treatment by Surgery on the Sympathetic.

Passe, E. R. Garnett and Seymour, J. S.: Brit. Med. J. (Nov. 6) 1948.

The authors discuss the various forms of treatment, both medical and surgical, of this syndrome, omitting only the excellent work performed by Day. They put forth a vascular case to explain the hydrops of the labyrinth and suggest that differences in the blood supply to different portions of the internal ear may well account for the relative differences in the degree of deafness and vertigo.

Since the vertebral artery supplies the internal ear they attack this vessel through the subclavian triangle and, after dividing or stripping it, they excise the stellate ganglion. Of the 12 patients operated upon all were relieved of their vertigo; in all but one the hearing was improved; in nine cases the tinnitus was modified or abolished. While this is only a small number of cases the results are encouraging. The twelve case reports are given.

GROVE.

The Use of Furacin in the Treatment of Aural Infections.

Douglass, C. C.: Laryngoscope 58:1274-1277 (Dec.) 1948.

The successful use of furacin (5-nitro-2-furaldehyde semicarbazone) in the treatment of 105 cases of aural suppurations is reported. The solution was administered to the affected ear six drops three times daily until elimination of disease or until it was felt that maximum benefit had been obtained.

VAN ALYEA.

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Use of Nitrofurantoin Therapy in External Otitis.

Anderson, J. R. and Steele, C. H.: Laryngoscope 58:1279-1285 (Dec.) 1948.

In a similar report to that of Douglass, these authors also found furacin an effective drug in the treatment of aural infections.

They explain the effectiveness of the drug in cases of external otitis on the assumption that most of the so-called fungus infections of the ear are fundamentally bacterial in nature.

The solution is applied in the form of saturated cotton wicks which are kept moist by the patient. In the presence of fungi a wick of 1% thymol in cresatin is applied the second day and left in place for six hours. This is also the method of treatment with aural furunculosis.

Three days of treatment should suffice in most cases.

VAN ALYEA.

Cholesteatoma in the Petrous Bone Causing Progressive Facial Palsy.

Lundgren, Nils: Acta Oto-Laryngologica 36:75, 1948.

A cholesteatoma may be present in the petrous apex despite the absence of local middle ear signs and symptoms. The characteristic symptoms of this condition are impaired hearing and slowly progressive peripheral facial palsy. Dizziness is not a common finding, even though caloric reaction is absent or difficult to induce in all cases. Diagnosis is established by x-ray, using the Stenver projection. Early surgery is indicated to improve or restore facial function.

Two cases proven by pathological examination are cited in this article. The question of the primary or secondary nature of the cholesteatoma is discussed but not solved.

SATALOFF.

PHARYNX

Malignant Plasmocytoma of the Nasopharynx.

Maurice M. Greenfield (Capt) M.C. A.U.S.: Radiology 50:661-665 (May) 1948.

A case of a primary extramedullary plasmocytoma of the nasopharynx occurring in an 18-year-old white male is reported. In July, 1943, multiple polypoid growths were removed from the nasopharynx. The tissue was diagnosed as plasmocytoma. In January, 1945, the right cervical lymph nodes become enlarged and biopsy in July revealed a plasmocytoma. The lesion in the left posterior sixth rib received 4000 "r" x-radiation and the lesion in the right lateral sixth rib 2600 "r". Slow but complete regression followed. In June, 1946, severe right orbital headache occurred and a nasopharyngeal nodule appeared. Biopsy revealed plasmocytoma. The tumor area received 6610 "r" x-radiation with only symptomatic improvement. The physical factors used are given.

JORSTAD.

ESOPHAGUS

Postcricoid Pharyngo-oesophageal Perforation Due to Endoscopy Treated by Immediate Suture.

Goligher, J. C.: Lancet 254:985 (June 26) 1948.

Two cases of postcricoid perforation are reported, one due to esophagoscopy and the other to gastroscopy. The first patient on whom an esophagoscopy was performed died in spite of the administration of 100,000 units of penicillin every three hours and a deep incision of the neck along the anterior border of the sternomastoid muscle where pus or gas was not encountered under tension.

In the second case gastroscopy was done on a male patient 63 years of age. Three hours after the gastroscopy the neck appeared swollen and surgical emphysema was detected on both sides. Radiography did not reveal any emphysema in the mediastinum. Four and three-fourths hours later an incision along the anterior border of the sternomastoid muscle was made. The omohyoid was severed. The sternomastoid muscle was retracted laterally and the strap muscles medially. After division of the middle thyroid vein and inferior thyroid artery, the thyroid cartilage was rotated and the posterior pharyngo-esophageal wall exposed. A circular perfora-

tion of the posterior wall of the pharynx, about half an inch in diameter, was found. After the insertion of a fairly large rubber tube down the pharynx to demonstrate the lumen of the perforation, this was closed by mucosal and muscle and fascia sutures. Penicillin-sulfanilamide powder was instilled and a rubber drain placed. Post-operatively, the patient received 100,000 units of penicillin every three hours and 1 gram of sulfamezathine every four hours. The patient was fed by stomach tube and by rectum for six days, after which he was able to swallow semisolid food. The patient made an uneventful recovery.

The author believes that perforation of the posterior wall of the pharynx or esophagus in the neighborhood of the cricoid cartilage constitutes a small but definite risk associated with gastroscopy and esophagoscopy. The predisposing factor seems to be the anterior prominence of the extended cervical spine, particularly when roughened by the presence of osteophytes. The prophylactic measures to be taken by the endoscopist include routine radiography of the neck to exclude dangerous cervical spurs and avoidance of undue extension of the neck at all stages. The correct treatment is immediate exposure and suture of the perforation, followed by drainage and intensive chemotherapy.

GROVE.

LARYNX

Roentgen Therapy for Carcinoma of the Larynx.

Harris, W., Kramer, R. and Silverstone, S. M.: Radiology 51:708-715 (Nov.) 1948.

Of 80 cases of squamous celled carcinoma (proven by biopsy) of the larynx treated primarily with x-ray, from 1931 to 1942 inclusive, 67 were suitable for statistical analysis. The five-year survival rate was 55%, for intrinsic lesions, 73%, and extrinsic lesions, 40%.

Of the group, 36 were intrinsic and 44 extrinsic according to the anatomical classification of Hayes Martin. From measurements in a water phantom, it was calculated that the majority of patients received a tumor dose of 4,000 to 6,000 "r". Technic, dose estimation and radiation reactions are outlined.

Total laryngectomies performed in nine x-ray failures were successful in one case. A number of factors or conditions indicating unfavorable response are discussed. Prognosis depended upon extent and location of the carcinoma. Cervical lymph node metastasis occurred, as a rule, late in the disease and was usually associated with an extensive lesion. These metastases may be controlled by surgical or radiological methods. Eleven tables of statistics are included.

JORSTAD.

BRONCHI

Bronchiectasis Following Aspiration of Timothy Grass

Carter, M. G., and Welch, W. J.: New England J. Med. 28:832 (June 10) 1948.

Eight cases of timothy grass foreign bodies in the bronchi are reported. Seven of these required lobectomy because of subsequent bronchiectasis or lung abscess. One, the youngest in the group, aged 14 months, recovered with bronchoscopic removal. In all cases the grass heads progressed peripherally, and in the older children was soon lost to bronchoscopic view. In the youngest child the smaller bronchi trapped the grass at a higher point. The value of studying unstained smears of bronchial secretion for timothy fibers in suspected cases is suggested.

HULL.

MISCELLANEOUS

Fatality Associated with Benadryl Therapy.

Blackman, Norman J. (Capt.) M.C., A.U.S. and Hay, James C. (Capt.) M.C., A.U.S.: J. Allergy 19:399 (Nov.) 1948.

The authors report the death of an asthmatic who had received benadryl just prior to the terminal episode. Since coma was present and autopsy failed, in the author's opinion, to reveal sufficient organic changes to explain her death, they felt that the primary cause of death may well have been severe depression of the central nervous system due to benadryl. They admit that objective proof of this is lacking. Nevertheless, their suspicions require that everyone who treats allergic individuals should proceed with caution in the administration of any new chemical compound. In this death were

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in fact due to benadryl it might perhaps have been prevented by giving a very small initial dose and observing the patient's response closely for a period of at least eight hours before giving a second dose.

SULLIVAN.

Levels for Pyribenzamine and Benadryl in Blood and Urine Following a Single Orally Administered Dose.

McGavack, Thomas H., Dreker, I. J., Schutzer, Seymour, and Heisler, Alexander: J. Allergy 19:251-255 (July) 1948.

The authors have attempted to perform benadryl and pyribenzamine "tolerance tests", measuring the quantity of circulating secondary amines before and at half-hour intervals after the oral administration of a single 400-mg. dose of either drug.

The resultant average blood level curve after benadryl is strikingly different from that after pyribenzamine. In the case of benadryl there is a high peak occurring 90 minutes after administration. After pyribenzamine there is no high peak; the curve is a gradual slope reaching its maximum at the end of three hours.

From this evidence it is permissible to conclude that the two drugs are metabolized differently, and not, as the essayists suggest, that the drugs have markedly different absorption times. It is evident from clinical experience that an oral dose of pyribenzamine is pharmacologically active 30 minutes after ingestion. Yet the level of secondary amines after pyribenzamine was found by the authors to be no higher than the pre-administration level.

SULLIVAN.

Side Effects of Three Antihistaminic Drugs.

Holtkamp, Dorsey E., Hagerman, Dwain D., and Whitehead, Richard W.: J. Allergy 19:384 (Nov.) 1948.

Ten normal college students were given, in average dosage, pyribenzamine, benadryl, hydryllin, and, as a control, lactose, each administered on different days. During the period of each pharmacological effect the students were subjected to objective measurement of the mental ability, reaction time, and two point discrimination. The general response indicated impairment of the functions measured following any of these antihistaminic drugs.

It is doubtful that any specific conclusions can be drawn from this study in which only ten individuals were tested, since this small number would not be appropriate for statistical analysis. It is noteworthy that administration of the control substance, lactose, was followed in some instances by an impaired response to one or more of the tests.

SULLIVAN.

Antihistamine Drugs in Hay Fever. A Comparative Study with Other Therapeutic Methods.

Weiss, William L., and Howard, Royal M.: *J. Allergy* 19:270-277 (July) 1948.

Results obtained with pyribenzamine and neoantergan are compared, basing the results in large part on the percentage of relief obtained by the patient. Since the basis of this study rests primarily on the patients' statements, objectiveness is lacking; this leaves some doubt in the reader's mind concerning the validity of the conclusions. Using this method it was found that more side reactions occurred with neoantergan.

The authors also attempted to evaluate results obtained from antihistaminics alone as compared with results obtained from hyposensitization supplemented with antihistaminics. Here an objective measurement was uncovered in that no patient who received pre-seasonal hyposensitization developed asthma, whereas ten other patients did develop asthma. Four of these ten were receiving antihistamine drugs alone; five had not yet been started on any therapy; and one was receiving co-seasonal hyposensitization alone. This finding suggests that, whatever may be the comparative results of various types of therapy on hay fever alone, adequate hyposensitization may exert a protective action against the development of pollen asthma and that the antihistaminics apparently do not offer this anti-asthma protection.

SULLIVAN.

Allergy in Otolaryngology.

Hansel, French K., Black, W. Byron, and Ashley, Rea E.: *Laryngoscope* 48:652-697 (July) 1948.

The presentation in three parts covers many phases of allergy including investigation, history taking, skin testing, diagnosis, allergic management and treatment.

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The Hansel technic of smear staining is described in detail and six drawings in color are shown depicting the usual types of nasal secretion common to nasal allergy and allergy combined with inflammation.

The authors maintain that early recognition and management of allergy will in large measure prevent the onset of many of the inflammatory sinus attacks, bronchial asthma, nasal polypi and the more severe manifestations of hay fever and perennial allergy.

Inhalants rather than ingestants and contactants usually are responsible for nasal allergy and, aside from the pollens, house dust is the principal offender.

In treatment a stock extract is used, the chief constituents of which are: cotton, flax, jute, wool, silk, animal hair, kapok, orris root, pyrethrum, tobacco, mold and fungi. This extract in coca solution is administered in minute dosage, the more prominent the symptoms the smaller the dose. In cases with extreme nasal blockage, sneezing and discharge the initial dose may be 0.1 cc. of a dilution of one to ten billion. Slight manifestations call for a dose of 1:100,000. The dosage is increased until relief is attained at that point. When the patient remains symptom free for three 21-day periods, treatment should be stopped.

An occasional set-back occurs, such as when the injections are spaced too far apart, when contact is made with an overpowering dose of antigen, when the patient is exposed to temperature and humidity changes, or in presence of acute infections, psychological upsets, fatigue, indiscretions of diet and overindulgence in alcohol and tobacco.

The results obtained are cessation of symptoms in a high percentage of cases, which lasts for periods varying from months to years, an improvement in cases of superimposed sinusitis and an improvement in the appearance of the nasal mucosa.

The authors admit that many points in the method of the procedure outlined, although having abundant clinical basis, are devoid of scientific basis, and that many of the unknown factors need clarification.

VAN ALYEA.

Antihistaminic Drugs in Treatment of Nausea and Vomiting Due to Streptomycin.

Bignall, J. R., and Crofton, John: Brit. Med. J. p. 13 (Jan 1) 1949.

The authors observed nausea and vomiting of 35% of 49 patients treated with streptomycin at the Brompton Hospital, but in only four of the patients were these symptoms severe and persistent. They believed that these toxic manifestations may have been due to hypersensitivity to streptomycin or to impurities in the preparations used. On this basis it was thought that these symptoms might respond to antihistaminic drugs. Controlled experiments were carried out in these four patients and it was found that the nausea and vomiting were considerably reduced or abolished when benadryl capsules were given, and returned when this drug was withheld.

To eliminate the power of suggestion they used inert capsules looking like the benadryl capsules at times when the benadryl was withheld, but the nausea and vomiting continued. To eliminate the slightly sedative effect of the benadryl they substituted capsules containing 1/2 gr. of phenobarbitone, but the administration of this drug was followed by an exacerbation of the symptoms which were again controlled by the administration of benadryl. They found that the dizziness caused by streptomycin therapy was not relieved by benadryl.

GROVE.

Tumors of Salivary Gland Origin.

Taylor, G. W., and Garcelon, B. B.: New England J. Med. 238:766 (May 27) 1948.

The differential diagnosis of mixed tumors and carcinomas is difficult. The former are more sharply defined, firm rather than hard, and movable, while carcinomas are less sharply defined, hard and tend to be fixed. Twenty-five per cent of the parotid carcinomas in the series reported had facial nerve involvement. Wide resection of the gland, with exposure and lifting out of the facial nerve branches when necessary, gives satisfactory results. The treatment of carcinoma is generally unsatisfactory. Unless seen early, radiation is not effective.

HILL.

Books Received

Diseases of the Nose and Throat.

A Textbook for Students and Practitioners. By Sir St. Clair Thomson, M.D., F.R.C.P. and V.E. Negus, M.S., F.R.C.S. 5th Ed. Pp. xix+1004, with 13 color, 20 radiographic and 11 other plates and 369 figures. New York, Appleton-Century-Crofts, Inc., 1949. (Price \$16.00).

Since its first appearance in 1911 St. Clair Thomson's *Diseases of the Nose and Throat* has been accepted, almost by common consent, as the outstanding text on the subject in the English language. Through four editions it has kept abreast of progress in the specialty, new material having been selected with the taste and discrimination for which its author was celebrated.

The present, fifth, edition carried forward after Sir St. Clair's death by his collaborator and disciple, Mr. V. E. Negus, not only continues in the old tradition of completeness and authenticity but achieves a certain freshness of its own.

This is no routine textbook, nor is it especially English. Mr. Negus, in the face of unusual difficulties imposed by the war and the disrupted publication and distribution of the world's medical journals, has managed to adduce a wealth of new references and thought which makes this a truly international work.

It has established itself as a classic and belongs in every medical library.

Diseases of the Ear, Nose and Throat.

By William Wallace Morrison, M.D., Professor of Otolaryngology and Attending Otolaryngologist, New York Polyclinic Medical School and Hospital; Senior Assistant Surgeon, in Otolaryngology, New York Eye and Ear Infirmary; Associate Clinical Professor of Otolaryngology, New York University College of Medicine; Captain, Medical Corps (U.S.N.R.) Pp. xviii+772, illustrated. New York, Appleton-Century-Crofts, Inc., 1948. (Price \$8.50).

As a writer and teacher the author of this text requires no introduction.

This present volume based upon the teaching material accumulated over a quarter of a century is directed to the requirements of the undergraduate student and the medical practitioner. It is char-

acterized by clear writing, careful choice of material and a simple diagrammatic type of illustration from the author's own pen.

For the convenience of the practitioner, there are appended a "Formulary of Prescriptions for Medications to be Used by the Patient" and an Index of Symptoms.

Oral Anatomy.

By Harry Sicher, M.D., Professor of Anatomy and Histology, Loyola University School of Dentistry, Chicago College of Dental Surgery. Pp. 529, with 334 illustrations. St. Louis, The C. V. Mosby Company, 1949.

The title of this very excellent work is an unfortunate understatement of its scope. While it gives the impression that the book may have been written for dentists and oral surgeons, there is scarcely a page or an illustration which is not instructive to anyone engaged in the care of the whole upper respiratory tract.

Nerves, fascial planes of the neck, anesthesia, ligation and many other matters of everyday interest to the laryngologist are well described and beautifully illustrated. Sections on the blood and lymph vessels of the head and neck are especially good.

Diseases of the Ear, Nose and Throat.

By Douglas G. Carruthers, M.B., Ch.M. (Sydney) F.R.A.C.S., Honorary Ear, Nose and Throat Surgeon, Sydney Hospital, and Eastern Suburbs Hospital, Sydney; Consulting Ear, Nose and Throat Surgeon, Canterbury District Memorial Hospital, Sydney. 2nd Ed., pp. viii+344, with 140 illustrations. Baltimore, The Williams and Wilkins Co., 1948. (Price \$7.00)

A small, practical and, for its size, comprehensive manual particularly adapted to the needs of the general practitioner.

Phylogenesis of the Ear. A monograph, tracing the phylogenesis of the ear from the lowest animal form, coelenterate, to man.

By Louis Guggenheim, M.D., Associate Professor of Otolaryngology, University of Southern California. 1st Ed., pp. 277, with 196 illustrations. Culver City, California, Murray and Gee, Inc., 1948. (Price \$12.50)

After forty years of delving into the tenuous literature on the subject, of nonproductive conversations with embryologists and finally of studying his own collection of serially sectioned embryos and those of others, the author has produced this monograph on the phylogenesis of the ear.

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After a short introductory chapter in which evolutionary changes are correlated with periods in the earth's history the text devotes itself to the development of the auditory organ from the coelenterates to the mammals, including man. While there is a considerable amount of detail, the treatment is too superficial to be of much scientific value and the illustrative material with the exception of some excellent photomicrographs is often so poorly drawn as to be practically indecipherable. The choice of exceptionally large type, wide spacing and arrangement is unfortunate both for the general appearance of the book and smooth reading.

400 Years of a Doctor's Life.

Collected and arranged by George Rosen, M.D., and Beate Caspari-Rosen, M.D.
Pp. xvii+429, New York, Henry Schuman, 1947. (Price \$5.00)

An engaging collection of autobiographical material dealing with the lives and works of medical men. The editors have adopted the novel expedient of arranging the excerpts from many writings of many great and near-great physicians as they fit into the periods of a man's life: Early Years, School Days, The Medical Student, and so on, to Reflections on Life and Death.

The subject matter, while not all of a medical nature, deals with the physician's slant on life, his reactions to its problems and his philosophy in times of crisis. Each selection is prefaced with a paragraph or two, by the compilers, on the author, and since there are well over a hundred of these some biographical flavor creeps into what would otherwise be purely an anthology.

Recommended reading for any protagonist of bureaucratic medicine.

Twentieth Century Speech and Voice Correction.

Edited by Emil Froeschels, M.D., President, International Society for Logopedics and Phoniatrics; President, New York Society for Speech and Voice Therapy.
Pp. x+321, illustrated. New York, Philosophical Library, 1948.

This small volume, the composite effort of nineteen outstanding workers in the field of speech correction, was produced to keep interested persons abreast of the times and trends. Advancement in the science of audiometry, in the perfection of hearing devices, radio, television and screen, not to mention the problems incidental to aviation, public safety and the national defense have all combined

to increase the interest of diverse groups in sound production and perception and its chief vehicle, speech.

The present work which deals with sound and word production and its deficiencies is approached from many angles by its authors independently. The presentation is simple and direct. The bibliography is adequate.

Doctors of Infamy. The Story of the Nazi Medical Crimes.

By Alexander Mitscherlich, M.D., Head of the German Medical Commission to U. S. Military Tribunal No. 1, Nuremberg, and Fred Mielke. Pp. xxxix+172, with 16 illustrations. New York, Henry Schuman, 1949. (Price \$3.00)

This is an account of the trial of twenty German physicians and three German civilian aids, for murder and other criminal acts purportedly committed in the interest of science upon political prisoners and unwanted minority groups in the prison camps of Buchenwald, Dachau and Strassburg.

Much of the material, which was collected by two Germans, one a medical man, consists of the unedited transcript of testimony given in 1947 before an American military tribunal in Nuremberg which subsequently condemned seven of the defendants to death and nine to imprisonment. Emphasis is laid upon the perversion of German medical thought and ethics by the Nazi ideology.

... about as revolting an evening's reading as one is likely to encounter anywhere.

Traitement Chirurgical de l'Otospongiose.

By Maurice Sourdilhe, Professeur de Clinique Oto-Rhino-Laryngologique a la Faculte de Medecine de Strasbourg. Pp. 253, with 32 illustrations. Paris, Masson et Cie, 1948. (Price 750 fr.)

This monograph is the latest of the author's communications dealing with his operations for the restoration of hearing in otosclerosis. The first appeared in 1929; the present publication follows his previous one by almost ten years and should prove of interest to those who have engaged in this work in the interval.

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L'Exploration Clinique en Oto-Rhino-Laryngologie, Technique et Séméiologie.

By George Portmann, Professeur de Clinique oto-rhino-laryngologique à l'Université de Bordeaux; Membre correspondant de l'Académie de Médecine
Pp. 934, with 541 illustrations and 11 color plates. Paris, Masson et Cie, 1948.
(Price 2500 fr.)

Amigdalitis Crónica—Diagnóstico y tratamiento. Cirugía de las Amígdalas Palatinas.

By Miguel de Paternina, M.D., San Sebastián, Spain. 1st Ed., pp. xx + 356, with 222 illustrations. Barcelona, Editorial Labor, 1948.

Theorie der Schneckenmechanik. Qualitative und Quantitative Analyse.

By Jozef Zwislocki-Moscicki, Durchgeführt im Elektroakustischen Laboratorium der Universitätsklinik für Ohren-, Nasen- und Halskrankheiten, Basel.
Acta Oto-Laryngologica Supplementum LXXII. Pp. 76 with 26 illustrations.
Solothurn, Buchdruckerei Gassmann A.G. 1948.

Kurze Klinik der Ohren-, Nasen- und Halskrankheiten.

By Dr. Erhard Lüscher, ordentlicher Professor der Ohren-, Nasen- und Halsheilkunde und Direktor der Universitätsklinik und Poliklinik für Ohren-, Nasen- und Halskranke in Basel. Pp. 513, with 201 illustrations. Basel, Benno Schwabe & Co., 1948. Imported by Grune & Stratton, Inc., New York. (Price, Bound, Fr. 54.)

Trattato di patologia e Clinica Otorinolaringologica.

By Pietro Caliceti, Ordinario di Clinica Otorinolaringologica dell'Università di Bologna. Volumes I and II. Pp. xii + 952, with 410 illustrations, and pp. vii + 825, with 407 illustrations. Bologna, L. Cappelli, 1948.

Notices

WASHINGTON UNIVERSITY

The Department of Otolaryngology, Washington University School of Medicine, Saint Louis, announces an eight months' course in otolaryngology beginning October 3rd, 1949.

Address communications to The Registrar Washington University School of Medicine, Euclid Avenue and Kingshighway, Saint Louis 10, Missouri.

STATE UNIVERSITY OF IOWA

An intensive two weeks' course in Clinical Audiometry will be offered at the State University of Iowa, June 1- to 28, 1949. The course will be conducted daily from 8:00 to 5:00 and will include lectures on audiometry, lip-reading, speech training for the hard of hearing, psychological problems of the acoustically handicapped and clinical otolaryngology; laboratory work, including observation and participating in hearing testing and hearing aid fittings for clinical patients in the Department of Otolaryngology and Oral Surgery, State University of Iowa Hospital; observation of the University's comprehensive speech pathology program; and special lectures and demonstrations by Professor John S. Steinberg of the Bell Telephone Laboratories and Mrs. Bernice Rutherford of the Rehabilitation Center, St. Paul, Minnesota.

One of the Iowa Hearing Clinics, involving medical, psychological, speech, audiometric and social work approaches to cases assembled by the Department of Otolaryngology and Oral Surgery, the Iowa State School for the Deaf, and the Speech Clinic will be scheduled during the intensive course.

For further information address: Professor Wendell Johnson, Director, Speech Clinic, State University of Iowa, Iowa City, Iowa.

AMERICAN HEARING SOCIETY

THE KENFIELD MEMORIAL FUND

A sum of money was subscribed in 1937 in memory of Miss Coralie N. Kenfield of San Francisco, California, a teacher who was known throughout the United States for her high ideals and advanced methods in teaching lip reading. This money was placed in the Kenfield Memorial Fund. The interest provides a scholarship known as the Coralie Noyes Kenfield Scholarship for Teachers' Training Courses for Teachers of Hard of Hearing Adults. (The Scholarship offered in 1949 is \$100.00) The American Hearing Society is the trustee of the Kenfield Memorial Fund.

Applications will be considered from any prospective *hard of hearing* teacher of lip reading to hard of hearing adults who lives in the United States and who can meet the following requirements:

A. Personal characteristics necessary for successful teaching.
B. Ability to read lips as certified upon examination by an approved instructor in lip reading.

C. A bachelor's degree, or

Two years of college work plus twelve semester hours of work in adult education, psychology of the handicapped, voice production and control, sight conversation, social service, or

Two years of successful experience in teaching in public or private schools, plus twelve semester hours of work in adult education, psychology of the handicapped, voice production and control, social service, or kindred subjects.

D. Professional training in lip reading distributed as follows:

Thirty clock hours of private instruction under an approved teacher of lip reading, or

Sixty clock hours of instruction in public school under an approved teacher of lip reading.

The winner of the scholarship may take the normal course from any normal training teacher, school or university in the United States offering a course acceptable to the Teachers' Committee of the American Hearing Society.

The applicant for the scholarship must be a prospective teacher. Applications from those who are teaching lip reading now can not be considered. The scholarship must be used within one year from the granting of the award.

Applications must be filed between March 1, 1949 and May 1, 1949, with:

Miss Rose V. Feilbach,
American Hearing Society.
817 14th Street, N. W., Washington 5, D. C.

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A direct appeal is being made to the 8,000 young physicians and dentists who were trained at government expense under the wartime Army Specialized Training Program and the Navy V-12 program, and who have given little or no service to the Armed Forces, to volunteer for active duty in one of the three Armed Services. It is estimated that the government expended almost \$10,000,000 to educate, feed and clothe the 8,000 men who participated in the wartime programs.

The appeal is also being directed to the 7,000 physicians and dentists who were deferred during the war to complete their medical or dental educations at their own expense, and who have not served in the Armed Forces, to volunteer for active duty.

Secretary of Defense James Forrestal said that by the end of July of this year, the Armed Forces will have lost almost one-third of the present number of physicians and dentists now in service. This will result in a shortage of about 1600 physicians and 1160 dentists. If this condition is allowed to develop the number will have increased to 2200 physicians and 1400 dentists by December.

If the present campaign for volunteers is unsuccessful consideration must be given to the following alternatives:

- (1) To ask for draft legislation covering physicians and dentists who have not responded to the call for volunteers.
- (2) To ask those men who served in World War II, and who hold reserve commissions, to re-enter for active duty in the Armed Forces.
- (3) To retain those men now on duty, but who are entitled to be relieved from the service upon completion of their respective tours of duty, until the shortage has been corrected.

Mr. Forrestal pointed out that this professional manpower shortage in the Armed Forces is so serious that legislation for a physician and dentist draft has already been prepared and is being held for possible use. He added, "We have an obligation to the millions of persons concerned. These include the men and women in the Armed Forces themselves, and the fathers and mothers of these men and women who depend upon the pledge of this Government to take care of the medical and dental needs of those who serve their nation throughout the world."

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HEARING AIDS ACCEPTED BY THE COUNCIL ON PHYSICAL MEDICINE
OF THE AMERICAN MEDICAL ASSOCIATION
(List Corrected to March 1, 1949)

Acousticon Model A-100	Radioear Model 45-M-magnetic bone conduction receiver
Aurex (Semi-Portable)	Radioear Permo-Magnetic Uniphone
Aurex Model C-B and Model C-A	Ravox (Semi-Portable)
Aurex Model F	
Aurex Model H	Silver Micronic Hearing Aid, Model 101
Beltone Mono-Pac	Silver Micronic Hearing Aids, Models 202M and 202C
Beltone Harmony Mono-Pac	Solopak Hearing Aids
Dysonic Model No. 1	Sonotone Audicles Nos. 530, 531 and 533
Electroear Model C	Sonotone Model 600
Gem Hearing Aid Model V-35	Sonotone Model 700
Maico Type K	Sonotone Model 900
Maico Atomeer	Superfonic Hearing Aid
Mears Aurophone Model 200	
1947 Mears Aurophone Model 98	Telex Model 22
Micronic Model 101 (Magnetic Receiver)	Telex Model 97
Microtone T-3 Audiomatic	Telex Model 612
Microtone T-4 Audiomatic	Telex Model 900
Microtone T-5 Audiomatic	Telex Model 1020
National Cub Model	Telex Model 1550
National Standard Model	Tonemaster Model Royal
National Star Model	Trimm Vacuum Tube Model 300
Otarion, Model A-1	
Otarion, Model A-3	Unex Model "A"
Otarion, Models A-4 J & S	Vactuphone Model 3
Otarion, Model E-1	
Otarion, Model E-1S	Western Electric Ortho-tronic Model
Otarion, Model E-2	Western Electric Model 63
Paravox Models VH and VL	Western Electric Model 64
Paravox Model XT	Western Electric Models 65 and 66
Paravox Model XTS	
Precision Table Hearing Aid	Zenith Radionic Model A-2-A
Radioear Model 45-CM	Zenith Radionic Model A-3-A
Radioear Model 45-M-magnetic air conduction receiver	Zenith Radionic Model B-3-A
	Zenith Model 75

All of the accepted hearing devices employ vacuum tubes.

OFFICERS

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Manuscripts should be typewritten, on one side of the paper only. They should be double spaced and widely marginated. If the material was presented before a scientific body, a footnote should indicate its name and the place and date of the presentation. Manuscripts should be revised and corrected for spelling, punctuation and grammar. The telegraphic style, omitting articles and conjunctions, sometimes employed for hospital records, is not acceptable for published articles.

References to other published articles must be complete and the data should be set down in the following, now commonly accepted order: author's surname, initials, title of article, journal, volume, page, month and year.

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